

PERSONALITY AND BEHAVIORAL CORRELATES OF SET-SHIFTING IN A
COLLEGE STUDENT SAMPLE

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Abstract

The aim of the present study was to provide context for understanding how set-shifting relates to personality and behavioral characteristics in a normal sample of college students. Set-shifting has generally been defined as the ability to efficiently switch mental tasks, or more broadly, to think flexibly. While many studies have previously focused on set-shifting in samples of individuals with psychopathology, no study had examined how set-shifting functions in a normal sample. In the current study, 191 undergraduate men and women were assessed using the Wisconsin Card Sorting Task – 64 card version (WCST-64), the Brixton task, the Trail Making Test (TMT) Parts A and B, and the Cognitive Flexibility Inventory (CFI). Self-report measures captured level of depressive, anxiety, eating disorder, and obsessive-compulsive symptomatology, perfectionism, systemizing, dietary restraint, emotion regulation, and five factors of personality (agreeableness, extraversion, emotional stability, conscientiousness, and intellect). Following examination of the full sample, individuals with elevated eating disorder ($n = 27$), anxiety ($n = 82$), and depressive ($n = 45$) symptomatology were considered separately. Bivariate correlations indicated only negligible correlations between many of the measures of set-shifting across samples. Associations between the independent variables and the measures of set-shifting were diverse, with some associations in a direction consistent with hypothesized relations between set-shifting and the independent variables, some showing a complex pattern apparently dependent upon degree of symptomatology, and several demonstrating a set of correlations opposite to the predicted model. The diversity in these findings underscores the necessity of additional research focusing on precisely defining set-shifting and examining the extent to which current tools can be considered appropriate measures of this variable.

TABLE OF CONTENTS

Introduction.....	1
<i>Set-Shifting</i>	1
<i>Measuring Set-Shifting</i>	5
<i>Set-Shifting: Construct Definitions and Operationalizations</i>	10
<i>Set-Shifting or Another Process?</i>	12
<i>Gender, Age and Set-Shifting</i>	14
<i>Medication's Impact on Set-Shifting</i>	16
<i>Set-Shifting and the Five-Factor Personality Model</i>	17
<i>Set-Shifting and Depression</i>	18
<i>Anxiety, Obsessionality, and Set-Shifting</i>	20
<i>Eating Disorders and Set-Shifting</i>	22
<i>Dietary Restraint</i>	27
<i>Perfectionism and Set-Shifting</i>	28
<i>Emotion Regulation</i>	32
<i>Systemizing and Set-Shifting</i>	32
<i>Hypotheses</i>	33
Methods.....	35
<i>Participant Recruitment</i>	35
<i>Procedures</i>	36
<i>Measures</i>	36
<i>Statistical Analyses</i>	48
Results.....	51
<i>Bivariate Correlations</i>	53
<i>Full Sample</i>	53
<i>High eating pathology</i>	57
<i>Elevated depressive and anxiety symptomatology</i>	63
<i>Gender Analyses</i>	65
<i>Linear Regression Analyses</i>	65
<i>Factor Analyses</i>	66
Discussion.....	68
<i>The challenge of measuring set-shifting</i>	68
<i>Set-Shifting and Cognitive Flexibility</i>	71
<i>Set-Shifting and the Independent Variables in the Full Sample</i>	73
<i>Set-Shifting, the Independent Variables, and Eating Disorder Symptomatology</i>	76
<i>Set-Shifting, the Independent Variables, and Other Symptomatology</i>	79
<i>Conclusions and Future Directions</i>	80
Appendix A: Tables.....	84
Appendix B: Self-Report Measures.....	96
References.....	119

LIST OF TABLES

1. Normality data for variables that exceeded suggested guidelines for skewness and kurtosis.	53
2. Bivariate correlations between measures of set-shifting and personality and behavioral characteristics.	84
3. Bivariate correlations among measures of set-shifting.	56
4. Means and standard deviations on measures of set-shifting for the full sample and participants with EAT-26 scores greater than 19.	57
5. Bivariate correlations between measures of set-shifting and personality and behavioral characteristics for participants with EAT scores greater than 19 ($n = 27$).	86
6. Bivariate correlations among measures of set-shifting for participants with EAT scores greater than 19.	61
7. Comparison of the impact of the independent variables on self-report and neuropsychological assessments of set-shifting and cognitive flexibility in both the full sample and higher eating pathology groups.	88
8. Means and standard deviations on measures of set-shifting for the full sample and participants with BDI scores greater than 20 and HADS Anxiety scores greater than 8.	64
9. Bivariate correlations between measures of set-shifting and personality and behavioral characteristics for participants with BDI scores greater than 20 ($n = 45$).	90
10. Bivariate correlations between measures of set-shifting and personality and behavioral characteristics for participants with HADS Anxiety scores greater than 8 ($n = 82$).	92
11. Results of multiple regression analyses with set-shifting, as measured by the CFI Alternatives subscale, regressed on anxiety, depression, perfectionism, emotion regulation, systemizing, and IPIP personality factors.	94
12. Results of multiple regression analyses with set-shifting, as measured by the CFI Control subscale, regressed on anxiety, depression, perfectionism, emotion regulation, systemizing, and IPIP personality factors.	95

Introduction

Set-Shifting

Demands from our constantly changing environment often require us to flexibly switch task, or our attention, quickly and efficiently. The importance of this ability has led researchers to examine the underlying cognitive process or processes responsible for this skill. In recent years, psychologists have turned toward neuropsychological tasks to provide objective and quantifiable data on such cognitive patterns. One neuropsychological variable representative of this flexibility is set-shifting, or the ability to move mentally between multiple tasks or rules (Roberts, Tchanturia, Stahl, Southgate, & Treasure, 2007). For example, while cooking dinner, one might need to alternate attention between chopping vegetables, boiling water, and attending to a child. In this case, our environment requires us to intentionally carry out a series of tasks with specific procedures, or a “task-set” (Monsell, 2003). This happens repeatedly throughout a person’s day, and the flexibility required by these sorts of shifts is helpful in functioning efficiently in many environments.

Historically, clinical neuropsychology focused on brain injury, with the size and location of the injury being of primary importance to the goal of treating the injury (Bigler, 1988). Specifically, set-shifting was typically utilized in diagnosing patients with frontal lobe damage (Graham et al., 2009). For example, research on the cognitive profiles of high-altitude mountaineers who have been exposed to prolonged hypoxia indicates that set-shifting deficits are present and associated with reduced grey matter density in brain areas involved in motor activity, as well as dysfunction in the prefrontal cortex (Di Paola et al., 2008; Regard, 1989). With the advent of neuroimaging, the utility of neuropsychological tools has shifted from damage localization to describing cognitive and behavioral changes associated with the injury.

As the localization of brain damage began to be integrated with behavioral and cognitive changes, neuropsychological measures have become more compelling to those studying psychopathology, offering tools to better understand the brain-behavior bases for multiple disorders. Set-shifting has often been included in this category, as the neuropsychological concept seems to translate well into clinical terms. Poor set-shifting is associated with the sort of rigidity, narrow focus, and inflexibility seen in many disorders (Abbate-Daga, Buzzichelli, Marzola, Amianto, & Fassino, 2014; Danner et al., 2012; Giel et al., 2012; Holliday, 2005; Johnson, 2009; McAnarney et al., 2011; Roberts, Tchanturia, Stahl, Southgate, & Treasure, 2007; Shott et al., 2012; K. Tchanturia et al., 2012). As will be seen in future sections, this has informed the conceptualization of several disorders and sparked research on treatment modules that target set-shifting specifically. Set-shifting, then, has become an informative and useful variable for those studying and treating psychopathology.

Despite the increasing research on set-shifting in clinical populations, surprisingly little is known about this variable and its correlates in a normal population. It seems clear that set-shifting should generally be conceptualized as a dimensional construct; it would be incorrect to categorize someone as either proficient or deficient at set-shifting. Rather, set-shifting ability is likely better characterized as a matter of degree on a spectrum from complete inability to highly skilled. Patients with brain damage or psychopathology may represent the extreme end of the spectrum, but there is little understanding of what this variable looks like in its non-extreme forms. It can be hypothesized that certain degrees of set-shifting ability would be related to particular personality characteristics and aptitudes for certain careers or pursuits. Thus, a general knowledge of how set-shifting can be described in a normal population is of potential use; yet, no study has linked set-shifting to these concepts. It remains unclear whether set-shifting is

associated with varying degrees of personality dispositions or behavioral tendencies. This framework is necessary to more fully understand the construct of set-shifting and the role that it plays in daily life. This study will attempt to fill part of that gap.

Of particular interest in this project is the relationship between set-shifting and the eating disorders, and associated behavioral and personality characteristics. Impaired set-shifting has been proposed as an endophenotype of eating disorders and particularly anorexia nervosa (AN), meaning that it is being considered as a behavioral manifestation with a genetic basis that is heritable and stable. Numerous studies have found evidence for set-shifting deficits in samples of eating disorder patients (Holliday et al. 2005; Tchanturia et al., 2012; Wu et al., 2014). It has been hypothesized that poor set-shifting can contribute to the development and maintenance of eating disorders (Roberts, Tchanturia, & Treasure, 2010; Shott et al., 2012; K. Tchanturia et al., 2011), and this seems to be consistent with clinical observations that patients with eating disorders tend to be rigid and persistent (Shott et al., 2012). Conceptually, dysfunctional set-shifting can be hypothesized to be a predisposing trait. This pre-existing rigidity may make dieting particularly attractive because of its rule-bound nature. The singular intention of losing weight may also be appealing to someone with the tendency to narrow one's focus toward a particular goal while ignoring conflicting information. Poor set-shifting ability may also facilitate the maintenance of eating disorders. A deficit in set-shifting would likely limit one's ability to attend to properties of a food that do not fit the person's current characterization of it as "good" or "bad" and would make it difficult for patients to incorporate foods into their diet which had previously been categorized as "bad". It would also hinder adding variety to typical food and eating routines. Additionally, a patient with AN spends a great deal of time and attention restricting caloric intake; the difficulty of losing weight necessarily forces weight loss

to become the central goal of the person's life. A neuropsychological characteristic that makes one prone to rigidly focus attention toward a specific goal without attention to other stimuli and feedback would facilitate ignoring physiological cues to eat in favor of the goal of restriction. This might also make one more likely to ignore the negative consequences of the eating disorder.

Importantly, results have not demonstrated set-shifting deficits in all patients with eating disorders (Andres-Perpina et al., 2011; Shott et al., 2012); thus, the conceptualization of impaired set-shifting as an endophenotype of eating disorders may not be fully appropriate. Instead, it may be better thought of as a predisposing trait for general psychopathology. Renwick et al. (2014) examined the neuro- and socio-cognitive profiles of patients with AN and found three patterns with respect to set-shifting: 1) a subgroup with a strength in WCST, 2) a subgroup with average WCST perseverations, and 3) a subgroup with a weakness in WCST performance. This suggests that set-shifting deficits are not a one-size-fits-all characteristic for patients with AN. The studies that fail to find these deficits in patients with eating disorders make it clear that poor set-shifting is not characteristic of all individuals with eating disorders, but an explanation for why this deficit is so pronounced in only certain patients is unknown. Researchers have examined the personality characteristics associated with set-shifting deficits in patient populations (Abbate-Daga et al., 2014; Lindner, Fichter, & Quadflieg, 2014; Pignatti & Bernasconi, 2013), but it is difficult to assess how much weight to give these associations in a clinical population when we do not know the extent of these relationships in a non-clinical population. This study will attempt to better understand how set-shifting is related to personality and behavioral characteristics, such as perfectionism and obsessionality, that are often associated with eating disorders. The examination of behavioral and personality traits associated with set-shifting in a college-student

sample will help in better understanding the nature of the relationship between set-shifting and eating disorders.

Measuring Set-Shifting

One problem facing researchers studying set-shifting is a lack of consensus surrounding terminology, and whether varying terminology is indicative of different constructs. Although the term “set-shifting” is often used interchangeably with terms like task-shifting and attention-shifting, Ravizza and Carter (2008) propose a difference between the terms set-shifting and task-shifting. They define a set shift as one that requires an attentional set change, or a change in attention towards a different property of the stimulus relevant for the task. For example, switching between reporting the color and the shape of a stimulus requires an attentional shift. They contrast this with task-shifting, or a change in the goal of the task. They provide the example of classifying a digit as odd or even; in this task, the participant is attending to the same property of the stimulus but the goal (i.e., report it as odd, or report it as even) changes. They acknowledge, however, that these two ideas are not easily parsed out. For example, one could treat the color/shape task as an attentional shift because the task repeats (consistently reporting the property of the stimulus) while the relevant stimulus property (color or shape) changes. However, one could also argue that the task is changing because the goal in one trial is to attend shape and ignore color, and the goal of the next trial is to attend color and ignore shape. This difference is not easily defined in experimental designs. The goal of this paper is not to flesh out the appropriate definitions for these terms, but rather to examine the role that the ability to switch attention, goal, or rule flexibly and efficiently plays in healthy populations. Nonetheless, this difference in terminology is a reminder that cognitive processes rarely break down into simple tasks, making them challenging to study.

Set-shifting has been measured using a number of different tasks, and many of these assess varying components of set-shifting. An understanding of the paradigms frequently used to measure set-shifting ability is necessary before examining findings related to set-shifting ability, as some of the discrepancies seen in results can likely be attributed to the fact that these tasks often measure different aspects of set-shifting. The multidimensionality of set-shifting and the impact that this has on research will be explored more thoroughly in later sections.

In many set-shifting paradigms, participants perform a single task on each trial. In some trials, the task changes (switch trial), whereas in others, the task remains the same (repeat trials) (Kiesel et al., 2010). The participant's performance in the switch trials is compared to performance in the repeat trials. Generally, there is a switch cost, or worse performance, in switch trials. This can be measured in reaction time and in error rates (Kiesel et al., 2010). Many of the first studies on set-shifting involved switching the task every trial (ABAB), and comparing this to performance on single-task blocks (AAA and BBB) (Kiesel et al., 2010). One of the first researchers to formally capture this ability was Jersild (1927). His experimental design required participants to perform one arithmetic task with a list of numbers, or to alternate between two arithmetic tasks with a list of numbers. Participants took longer to complete the mixed-task blocks (ABAB) than the single-task blocks (AAA and BBB) (Kiesel et al., 2010). Kiesel et al. (2010) indicate, however, that this type of design conflates working memory with set-shifting, as the participant is required to keep the rule for both sets in mind during the mixed-task block. Although other designs have been developed, this idea of conflation with other cognitive processes will continue to be an issue in measuring set-shifting. Further designs capturing set-shifting include alternating-runs paradigms, in which a task switches after a regular number of trials (AABBAABB) (Kiesel et al., 2010). A task-cuing paradigm involves a random order to

switches and repetitions. To instruct the participant which task to perform, a cue either precedes or accompanies the stimulus (Kiesel et al., 2010). In an intermittent instructions paradigm, participants perform a sequence of trials under the same task and are then interrupted at random times by a cue informing them to perform a different task for the following sequences (Kiesel et al., 2010). A recent experimental design involves voluntary task selection, in which the participant decides which task to perform in each trial. Despite the voluntary decision to switch tasks, switch costs are still associated with this type of task (Kiesel et al., 2010).

One paradigm frequently used to measure set-shifting is a card sorting task. The Wisconsin Card Sorting Task (WCST) can be administered using a computer or pen and paper. It involves participants sorting cards based on the color of the card, the shape on the card, or the number on the card. There is a particular sorting rule that the participant has to decipher, and feedback is provided to the participant during the task to indicate whether the correct rule is being used. Once the participant has learned the rule, the rule switches; this pattern repeats several times. The switch cost is typically measured using perseverative errors, or the continued use of an obsolete rule (Grant and Berg, 1948).

The Cambridge Neuropsychological Test Automated Battery's (CANTAB) Intra/Extra Dimensional Set Shift task is considered theoretically similar to the WCST. This task involves two types of stimuli: colored shapes and white lines. Initially, the participant sees two colored shapes and guesses which one is correct. The computer provides feedback, and after six correct responses, the rule changes (Robbins, 1998).

The Trail Making Test Part B is another frequently used measure for set-shifting. In this task, participants are handed a paper with numbers and letters in circles placed randomly on a page. The participant is asked to draw a line alternating between numbers and letters in

ascending order. The time to complete this task is then compared to an easier version in which there are only numbers on the page (Reitan, 1958; Sanchez-Cubillo et al., 2009).

The CatBat task involves a short written story with missing words. The participant must determine whether “cat” or “bat” fills in the blank most appropriately (Eliava, 1964; Tchanturia et al., 2004). The outcome measure is based on the number of incorrect choices the participant makes. Finally, the Haptic Illusion task involves three wooden balls: two equally sized and small, and one larger. Initially, the larger ball and one of the smaller balls are placed in the participant’s hands (one right, one left), and the participant is asked to judge which is larger. After several trials, the experimenter replaces the larger ball with the second smaller one. Most participants will experience the illusion that the ball in the hand previously holding the larger ball is smaller (Tchanturia, Davies, & Campbell, 2007; Uznadze, 1966). These tasks will be discussed in more detail in further sections, but this initial understanding of the ways in which psychologists measure set-shifting will allow for a better understanding of the difficulties that arise in quantifying set-shifting.

Several self-report measures of cognitive flexibility have also been constructed and validated, but do not tend to show convergent validity with the above neuropsychological measures of set-shifting. Johnco, Withruh, and Rapee (2014) measured the reliability and validity of two such self-report measures: the Cognitive Flexibility Inventory (CFI) and the Cognitive Flexibility Scale (CFS). These measures include items that have face validity for cognitive flexibility (i.e., from the CFI: “I consider multiple options before making a decision,” “I like to look at difficult situations from many different angles”). They reported good internal consistency for both measures, but mixed convergent validity with the neuropsychological tasks, including the WCST, TMT, Controlled Oral Word Associations Test, the Stroop Color-Word

Associations Test, and the Ruff Figural Fluency Test. The CFI Total score had small but significant correlations with the Stroop Test ($r = .43$), the TMT-B ($r = .31$), the COWAT ($r = .41$), the RFFT unique designs ($r = .25$), and WCST perseverative errors ($r = .23$). The CFS showed less convergence. Additionally, in a clinical sample, both scales showed less statistically significant convergence, but still showed small effect sizes in certain tasks (WCST: $r = .28$). Many factors could have limited the ability to detect statistically significant correlations, including a limited sample size. Still, one would expect that the self-report measures would show stronger correlations with the neuropsychological tasks if they were truly capturing the same construct.

Further evidence for the discrepancy between self-reported cognitive flexibility and neuropsychological measures of set-shifting was provided through Dennis and Vander Wal (2010)'s description of the development and validation of the CFI; this scale was designed to measure "the type of cognitive flexibility necessary for individuals to successfully challenge and replace maladaptive thoughts with more balanced and adaptive thinking" (p. 241). It is intended to measure the tendency to perceive difficult situations as controllable, the ability to recognize multiple explanations for events and behavior, and the ability to generate several solutions to problems. The authors point out that the degree of similarity between these characteristics of cognitive flexibility and the neuropsychological assessments for set-shifting is uncertain. They offer the explanation that the neuropsychological measures of set-shifting might measure a type of flexibility that is more trait-like, and perhaps indicative of brain abnormalities. The self-report measures for cognitive flexibility, on the other hand, are more state-like and affected by emotions. Additionally, as will be further discussed in later sections, different neuropsychological tasks intended to measure set-shifting capture varying dimensions of set-

shifting (Tchanturia et al., 2004); the fact that these neuropsychological tasks might not be capturing the same concept makes it less surprising that they do not show convergent validity with self-report measures. The CFI appears to have good face validity for mental flexibility, but does not appear to have items that capture perseveration, or the persistent use of a rule despite negative feedback for the use of that rule. Many studies of set-shifting use the perseveration total from the Wisconsin Card Sorting Task as one of the main outcome variables. It seems, then, that the two methods of measuring cognitive flexibility might truly be capturing different constructs. The possibility also exists, however, that we do not have accurate insight into our own set-shifting ability, or perhaps these scales produce reactive responses such that participants are motivated to seem more flexible than they truly are; this would make self-report an invalid method for measuring set-shifting.

Set-Shifting: Construct Definitions and Operationalizations

As previously noted, inconsistencies seen in the nature of set-shifting could be related to investigators' treatment of a multidimensional variable as a unidimensional construct. Although set-shifting has been argued to consist of multiple component abilities, it is typically treated as a single concept; cross-study comparison of different components of set-shifting is likely inappropriate. Tchanturia et al. (2004) used factor analysis to discriminate between four factors of set-shifting: simple alternation, mental flexibility, perseveration, and perceptual shift. In samples of patients with AN, bulimia nervosa (BN), and healthy controls, the investigators used a battery of assessments intended to capture set-shifting ability and found that they loaded in different ways into these four factors. The outcome measures that loaded onto each factor help in understanding the conceptual differences among the factors. Simple alternation consisted of the number of errors and total time on the Trail Making Task Part B and the Brixton total number of errors, and the authors suggest that it represents correct rapid alternation between sets. Mental

flexibility included the CatBat time to completion and the number of repetitions on a verbal fluency task. The authors do not hypothesize a possible conceptual basis for this factor, but perhaps it is indicative of flexibility under time constraints. The perseveration factor included the number of errors on the CatBat task and the number of errors on a visual set task. Again, the authors offer no conceptual hypothesis for this factor, but it can be thought of as representing the persistent use of an obsolete rule. Finally, the perceptual shift task contained only the Haptic illusion task. Further research is needed to better understand the differences between these factors and the tasks that load onto them.

Several other studies have similarly found that set-shifting deficits were dependent upon the specific component of set-shifting analyzed. Fitzpatrick, Darcy, Colborn, Gudorf, and Lock (2012) examined set-shifting in a sample of adolescents with AN, and designed the neuropsychological battery they used to represent several components of set-shifting: motor and visual set-shifting, verbal set-shifting, and verbal inhibition and set-shifting. Heled, Hoofien, Bachner-Melman, Bachar, and Ebstein (2014) found that currently ill and weight restored patients with AN had deficits in sorting tasks involving a visuo-spatial component, but no deficits in sorting tasks requiring verbal ability. This lends support to the idea that part of the reason for discrepancies reported in studies of set-shifting could be the use of disparate conceptualizations of set-shifting. Without either a clear and comprehensive definition of set-shifting or an analysis that includes all possible components of set-shifting, cross-study comparison is difficult.

It seems evident that the findings on set-shifting ability are also at least partly dependent on the operationalization of the concept. As previously discussed, there are numerous paradigms to measure set-shifting, and the application of these operationalizations to studying set-shifting in

a sample of patients with eating disorders illustrates how the specific task used affects the outcome. Several studies that operationalized set-shifting using the WCST found set-shifting deficits in a sample of patients with AN, whereas studies using the CANTAB have not found such a deficit (Roberts et al., 2007). Furthermore, the effect sizes have varied in magnitude in studies using the TMT, the WCST, the CatBat Task, and the Haptic Illusion task (Roberts et al, 2007). In their meta-analysis of studies measuring set-shifting in patients with eating disorders and obesity, Wu et al. (2014) found varying effect sizes based on the type of neuropsychological assessment used; the TMT and the WCST had a Hedge's g that would be considered medium, whereas the Haptic Illusion task had a large Hedge's g and the Intradimensional/Extradimensional set-shifting task of the CANTAB was non-significant. It seems reasonable, then, to conclude that these tasks are not equivalent, or are measuring different constructs.

Set-Shifting or Another Process?

Previously, the difficulty of parsing out specific cognitive processes involved in a single task was noted. The implications stemming from this are discussed in several articles. Wildes, Forbes, and Marcus (2014) argue, for example, that the perseverative errors outcome on the WCST can represent two neurocognitive processes: “(1) attentional set-shifting, i.e., the ability to shift attention away from one abstract stimulus dimension (e.g., color) toward another (e.g., shape); and (2) reversal learning, i.e., the ability to override a recently acquired stimulus-reinforcement association (e.g., matching based on color) to apply a new stimulus-reinforcement association (e.g., matching based on shape)” (p. 227). They argue that this distinction is important because these two processes also have distinct neural correlates that substantiate their differences.

Wu et al. (2014) also note the possibility that inconsistencies among findings using different set-shifting tasks may be related to the conflation of set-shifting with other cognitive abilities. For example, many of the tasks used often require performance monitoring in addition to set-shifting (Wu et al., 2014). Wu et al. (2014) define monitoring as the process of “interpreting task-relevant cues and feedback signals appropriately to guide adaptive behavior” (p. 3378). Although this might be the case, there are insufficient data to conclude with confidence how significantly other cognitive abilities impact a person’s performance on these tasks. Robbins et al. (1998) performed a factor analysis of subtests of the CANTAB to determine whether the individual subtests are truly separate. They found that their measure of set-shifting, the Intra/Extradimensional Task, loaded completely onto its own factor; however, other tasks intended to measure set-shifting loaded with tasks meant to represent problem-solving. The authors suggest that set-shifting functions probably contribute to efficient problem solving; however, the exact nature of the relationship between set-shifting and problem solving could not be determined. The investigators provided evidence that neuropsychological measures may not purely measure one cognitive process; the intercorrelations of many cognitive processes make it difficult to know to what extent other abilities might impact set-shifting. Similarly, O’Donnell, MacGregor, Dabrowski, Oestreicher, and Romero (1994) used factor analysis to determine the loadings for several neuropsychological tasks. They found that the TMT-B and several other tasks loaded onto an attentional focus and psychomotor speed dimension, lending support to the idea that the TMT is another neuropsychological task that requires more than set-shifting ability. Until the contributions of each cognitive process to performance on neuropsychological tasks are parsed out, it is impossible to determine precisely what is being measured.

Gender, Age and Set-Shifting

Minimal information is available regarding gender differences in set-shifting ability, and the studies that have examined this relationship often have conflicting results. In a cross-sectional sample of forty-nine healthy participants aged 8-30, Kalkut, Han, Holdnack, and Delis (2009) did document statistically significant effects of gender on set-shifting abilities, with women performing better than men. Additionally, there were age by gender interaction effects, indicating that men's and women's development of set-shifting follow different courses. This interaction term predicted more variance in set-shifting than IQ, age, and gender alone. The authors suggest that this may be related to pubertal changes, as men tend to "catch up" to women's performance later in life. The authors also acknowledge that this finding only adds to inconsistent findings from other studies that have failed to show any gender differences. Lowe and Reynolds (1999), for example, failed to find any effect of gender on set-shifting in an older population. Without a better understanding of how gender is related to set-shifting ability, it seems unlikely that researchers and clinicians will be able to understand the determinants and consequences of set-shifting.

Few studies examining the pattern of set-shifting in clinical samples include gender as a variable. Many studies have explored the relationship between set-shifting and eating disorders, but the majority of these studies excluded males from their samples. In their recent meta-analysis of studies examining set-shifting in patients with eating disorders and obese patients, Wu et al. (2014) reported that only 4 of 54 studies included male participants. The studies examining set-shifting in patients with obsessive-compulsive disorder either did not report the gender make-up of their samples or included much smaller samples of men than women (Chamberlain et al., 2006; Chamberlain et al., 2007).

Evidence on the relationship between age and set-shifting has demonstrated that set-shifting ability may decline past the age of 50; evidence for a relationship between age and set-shifting until that point has been inconsistent (Fitzpatrick et al., 2012; Lang, Stahl, Espie, Treasure, & Tchanturia, 2014; McAnarney et al., 2011; Robbins, 1998). Robbins et al. (1998) measured a battery from the CANTAB in healthy participants aged 21 to 79 years. They found that their measure of set-shifting was the only subtest in the battery to be related to age. Young participants (<55 years) were found to perform significantly better than older participants (>55 years). They also point to consistency between this finding and other studies of decline in WCST performance between the ages of 50 and 59. Many of the studies examining set-shifting in psychopathology, however, have an age range that does not include adults over 50 years old; thus, these studies might not find evidence of the relationship that Robbins et al. (1998) demonstrated. Studies examining the relationship between age and set-shifting in samples of patients with eating disorders, for example, tend to focus on the difference between adolescents and adults. Lang et al.'s (2014) meta-analysis of studies examining set-shifting ability in children and adolescents with AN concluded that set-shifting deficits found in adult patients with AN are not pronounced in a similar sample of children and adolescents; the differences between adolescents with AN and adolescent healthy controls were non-significant and yielded small effect sizes. This could indicate that set-shifting deficits seen in adult AN patients are resulting from the duration of the disorder, or it could be interpreted as evidence of a relationship between age and set-shifting. If set-shifting ability is not fully developed until later adolescence, the differences between ill and healthy adolescents' set-shifting may not be pronounced.

Some of the inconsistency seen in studies examining age and set-shifting might also be partially explained by the use of varying operationalizations of set-shifting. As previously

discussed, the number of paradigms for operationalizing set-shifting can prove problematic when attempting to compare studies. Fitzpatrick et al. (2012) found mixed set-shifting deficits in adolescents with AN. They obtained no significant differences between healthy controls and adolescents with AN on any tasks, but the effect size for the differences between the groups varied based on the task: TMT, Verbal Fluency, WCST perseverative errors all showed a small effect size, but WCST categories completed showed a medium effect size ($d=.46$), as did the Brixton raw score ($d=.40$). The fact that the differences between these two groups were not statistically significant could be due to the study's small sample size (32 adolescents, 22 healthy controls). Further evidence for the presence of set-shifting deficits in adolescent AN patients is provided by McAnarney et al. (2011). The investigators did find significant differences with medium to large effect sizes between a healthy control group and a sample of adolescent patients with AN on the WCST total errors and total perseverations scores; however, they did not find significant differences on the CANTAB Intra/Extradimensional shifting task and the effect size for this difference was small. Taken together, these findings suggest an age effect on at least certain components of set-shifting, but this relationship requires further exploration.

Medication's Impact on Set-Shifting

The inconsistency in studies' exclusion criteria for psychotropic medication also makes it difficult to compare findings across them. Wu et al. (2014) reported that, out of their sample of 54 studies, 11 reported participants with no psychotropic medication use, 17 included patients taking selective serotonin reuptake inhibitor medications, and smaller numbers of studies included patients taking low-dose antipsychotic medication and benzodiazepine treatments. Billingsley-Marshall et al. (2013) report this limitation for their study of executive function in patients with AN, noting that this not only increases individual variability but also introduces a confounding variable because antipsychotics and benzodiazepines have been shown to alter

cognitive performance on many tasks. The specific impact of psychotropic medications on the cognitive processes involved in set-shifting is currently unknown. A sample of non-clinical participants would allow researchers to examine the variables affecting set-shifting ability in the absence of psychotropic medications.

Set-Shifting and the Five-Factor Personality Model

Although the structure of personality has been debated among personality psychologists, it is beyond the scope of this project to outline the many theories on the structure of personality. The 1980s saw more convergence towards the Five-Factor model of personality; this dimensional model incorporates both normal and abnormal personality traits and considers these traits to exist on a spectrum (Costa & McCrae, 2014). These factors broadly assess chronic propensity towards extraversion, agreeableness, conscientiousness, emotional stability or neuroticism, and openness or intellect (Costa & McCrae, 2014). The dimension represented by extraversion has been considered to measure the extent to which an individual is energetic and group-oriented versus solitary. Agreeableness captures a spectrum with strong levels of trust and kindness towards others at one end and competitiveness at the other. Conscientiousness reflects degree of fastidiousness, ranging from extremely disciplined to generally careless. Neuroticism or emotional stability represents the degree to which an individual chronically experiences emotional distress. Openness or intellect is considered the extent to which an individual takes a curious and imaginative approach versus one that is more traditional or pragmatic (Cost & McCraw, 2014).

The nature of any relationship between set-shifting and these personality traits has yet to be examined. Despite the scant research base from which to draw hypotheses, the conceptual link between certain of these characteristics and set-shifting can be speculated. For instance, those people who are generally open to new experience and have preferences for novelty may have

greater set-shifting ability. Additionally, there may be a link between neuroticism and set-shifting insofar as those who have higher levels of neuroticism experience more emotions that are hypothesized to negatively affect set-shifting (i.e., depression and anxiety). This study will explore whether any of these five factors are related to set-shifting ability.

Set-Shifting and Depression

The nature of set-shifting ability in patients with depressive disorders has been examined in several studies. Clinically, a deficit in set-shifting can be seen as a predisposing and maintaining factor in depression. A cognitive predisposition to ignore contrary evidence and only attend using the rules one has already developed might lead someone to fail to see indications that he or she is a generally good and successful person, and could contribute to the “all or none” thinking that is often seen in patients with depression. Set-shifting deficits may also help maintain the disorder by keeping patients in their negative framework for interpreting events and information, with resistance to contrary evidence. Patients with depression who are resistant to changing the framework they use to interpret events may be considered to be inflexible in their cognitive style.

Patients with unipolar depression do generally show impairment in set-shifting, although it remains unclear whether the severity of depressive symptoms impacts this relationship (Austin et al., 2001). These deficits do tend to persist after recovery, lending support to the hypothesis that impaired set-shifting is a predisposing trait for depression. However, the possibility remains that these deficits could be the long-term result of recurrent depressive episodes. Grant, Thase, and Sweeney (2001) found that patients with major depressive disorder completed fewer categories on the WCST ($d=-.42$), had increased perseveration ($d=0.48$), and poor maintenance of set ($d=0.51$). Yet, there was no evidence of set-shifting dysfunction on the CANTAB Intra/Extradimensional task, controlled oral word association test (COWAT), or the TMT, again

underscoring the point that not all set-shifting tasks are equivalent. Additionally, it is notable that this study did not exclude patients with comorbid anxiety, eating, or substance use disorders, nor did they quantify the symptoms associated with these diagnoses; this makes it difficult to know if the differences in set-shifting were due to depressive symptoms and makes cross-study comparison more challenging. Similarly, Merriam, Thase, Haas, Keshavan, and Sweeney (1999) used the WCST and found that patients with major depression made more perseverative and nonperseverative errors ($d=0.72$ and $d=-.42$), took longer to reach the first category in the WCST ($d=0.42$), and completed fewer categories overall than the control group ($d=0.49$). Notably, this study included only patients who had been unmedicated for at least 28 days. Once again, it is clear that varying exclusion criteria are problematic for cross-study comparison.

Further evidence regarding the nature of the relationship between set-shifting and depressive symptoms is perhaps provided by studies of set-shifting in patients with eating disorders. However, caution should be used in interpreting scores on depression inventories in samples of currently underweight patients. As described in Keys, Brozek, Henshel, Mickelson, and Taylor (1950), one of the consequences of starvation is depression; in studies with samples of currently underweight patients, it is unclear whether the depression being measured results from starvation, and whether that is qualitatively different from major depressive disorder. In these studies, authors tended to measure depressive symptoms in the patients and either correlate the scores from the measure of depression with set-shifting ability, or use the measure of depression in partitioning the variance of set-shifting ability. Results from these studies are remarkably mixed, with some investigators finding a relationship between depression and set-shifting in patients with AN and others failing to find such a relationship. These studies will be discussed in further detail in later sections.

After reviewing the literature on the nature of the relationship between set-shifting and depression, it seems that deficits in set-shifting generally can be associated with increases in depression; however, variability across different measures of set-shifting are again evident. The neuropsychological task used impacts the conclusions drawn, as studies using the WCST consistently report deficits in set-shifting whereas those using the Brixton task do not. The impact of psychotropic medications is also unclear and undoubtedly introduces variance. Additionally, the measure of depression likely impacts the studies' findings. Interestingly, the picture of this relationship when examining a singular diagnosis of depression seems to change when measured in samples of patients with eating disorders. As will be seen in later sections, the evidence for a relationship between set-shifting and depression is more varied in samples of patients with eating disorders. This might be evidence that set-shifting deficits are a predisposing trait for general psychopathology, or a consequence of multiple symptom patterns. An understanding of the relationship between these variables in a non-clinical sample would help in better characterizing the relationship in a clinical population.

Anxiety, Obsessionality, and Set-Shifting

The only studies of set-shifting in the context of anxiety disorders focus on obsessive-compulsive disorder (OCD). It is unclear why other anxiety disorders have not been examined. Future sections will explore the nature of the relationship between anxiety and set-shifting in samples of patients with eating disorders, but further investigation of this relationship in samples of patients with anxiety disorders would be of value. A cognitive tendency to ignore evidence contrary to one's current belief system would seem to be a potential predisposing and maintaining factor in phobias and generalized anxiety disorder.

The notion of poor set-shifting fits well into the clinical picture of OCD. Longitudinal research is needed to better understand at what point cognitive rigidity appears, but it is

hypothesized to contribute to the development and maintenance of OCD. A cognitive predisposition towards focusing one's attention towards a particular characteristic of a stimulus may facilitate the development of the obsessions seen in patients with OCD. Additionally, it would seem likely that a cognitive tendency to persist in following a rule despite negative feedback about that rule would help maintain a disorder clinically characterized by rigid adherence to compulsions despite negative consequences.

Several studies have examined the nature of the relationship between obsessionality and set-shifting in patients with OCD. Chamberlain et al. (2006) used the Yale-Brown Obsessive Compulsive Scale to measure obsessionality in patients diagnosed with obsessive-compulsive disorder (OCD). Patients with OCD required significantly more trials in the Extradimensional component of the Intradimensional/Extradimensional Shift Task, indicating a set-shifting deficit when compared to healthy controls ($r=.29$). The authors note that this portion of the task is similar to what would be required in the WCST. Notably, this did not correlate with severity of symptoms. In a similar study Chamberlain et al. (2007) used the Yale-Brown Obsessive Compulsive scale to measure set-shifting ability in patients with OCD and their first-degree relatives without an OCD diagnosis. Both patients with OCD and their relatives required more trials at the Extradimensional shift stage of the Intradimensional/Extradimensional Shift Task when compared to healthy controls (patients: $r= 0.41$; relatives: $r= 0.45$). Again, this did not correlate with severity of symptoms in the patient group. The presence of this deficit in healthy first-degree relatives also provides evidence that set-shifting deficits are relevant in a non-clinical population. The evidence thus far seems to indicate that deficits in set-shifting are associated with increases in obsessionality.

Eating Disorders and Set-Shifting

Set-shifting has been studied fairly extensively in samples of patients with eating disorders. As previously discussed, the notion that a deficit in set-shifting is present in this population of patients fits well into the conceptualization of the development and maintenance of these disorders. A deficit in set-shifting could support the tendency of many patients with AN to have strict and unyielding rules surrounding food. Such a deficit could also aid in the narrow-mindedness required to make restriction one's central goal. However, not all studies have found such deficits. It is important to consider that these studies provide evidence that dysfunctional set-shifting is not common to all patients with eating disorders. In particular, set-shifting is more characteristic of patients with AN than patients with other eating disorders (Galimberti, Martoni, Cavallini, Erzegovesi, & Bellodi, 2012).

Studies of patients with AN can also provide evidence for the nature of a relationship between set-shifting and depression, set-shifting and anxiety, and set-shifting and obsessionality. As previously noted, these studies are, in certain ways, difficult to interpret because of the substantial impact of starvation (Keys et al., 1950). Comorbidities in patients with eating disorders can arise as a result of the starvation, and thus may be qualitatively different from major depressive disorder, generalized anxiety disorder, and obsessive-compulsive disorder. Thus, studies examining the relationship between set-shifting and depression, anxiety, and obsessionality in samples of patients with eating disorders may not be measuring the same construct as a study that examines these associations in samples of patients without eating disorders. Nonetheless, these studies may be informative of the characteristics of set-shifting in samples of patients with comorbidities. Holliday et al. (2005) used the Hospital Anxiety and Depression Scale to capture depression in patients with AN and control patients. Their analysis revealed no correlation between depression and participants' set-shifting ability when measured

by the CatBat task, Brixton test, or the TMT. However, the number of perceptual illusions measured by the Haptic Illusion Task was positively correlated with depression scores ($r=0.27$). Again, it becomes clear that the tool used to measure set-shifting matters. Giel et al. (2012) set out to explicitly examine the relationships between unipolar depression, eating disorders, and set-shifting. They used the TMT, WCST, and a Go/No-Go Test to indicate set-shifting ability. They found that patients with unipolar depression performed significantly more poorly in all three tasks when compared to patients with AN, and their performance on the TMT was more impaired than that of healthy controls. Giel et al. (2012) also reported a moderately negative correlation between severity of depressive symptoms and set-shifting. The authors conclude that impaired set-shifting in patients with eating disorders may actually be due to comorbid depressive disorders.

Contrary to Giel et al. (2012) and Holliday et al. (2005), several studies have found that depressive symptoms in patients with eating disorders were unrelated to set-shifting ability (Shott et al., 2012; Steinglass et al., 2006; Tchanturia et al., 2004). Roberts, Tchanturia, and Treasure (2010) used the Hospital Anxiety and Depression Scale, and a composite score from AN and BN participants' performance on the TMT, the WCST, the Brixton Task, and the Haptic Illusion task as an overall indicator of set-shifting. They found that self-reported depression was weakly correlated with this composite score ($r<.08$). This may reflect a true absence of association between set-shifting and depression in patients with AN or BN, or may result from their methodological choices. Their method of measuring set-shifting does capture more than one aspect of the construct, but the investigators artificially dichotomized the sample into two groups: poor set-shifting and intact set-shifting. Through this process, they might have lost valuable information about differences between the neuropsychological tasks. Shott et al. (2012)

used a structured interview to determine if a diagnosis of depression was appropriate and found no relationship between depression diagnosis and the measure of set-shifting ability in their sample of adolescents with AN. Steinglass et al. (2006) and Tchanturia et al. (2004) similarly found no relationship between scores on depression scales and any measurement of set-shifting in samples of patients with AN and BN.

Similarly to depression, studies examining the nature of set-shifting deficits in samples of patients with eating disorders often include anxiety as a variable; these studies, then, may also help clarify whether a relationship between anxiety and set-shifting exists in samples of patients with eating disorders. Research findings on the possible relationship between anxiety and set-shifting seem to show relatively consistently that there is no significant relationship between these two variables within samples of patients with eating disorders. Holliday et al. (2005) used the Hospital Anxiety and Depression Scale to measure anxiety symptoms in their sample of patients with diagnosed eating disorders. They found that anxiety was not significantly related to the CatBat task, the Brixton task, or the Trail Making Test. Lindner et al. (2014) similarly failed to find a relationship between scores on the Beck Anxiety Interview and set-shifting ability in a group of patients recovered from AN and in a control group. Additional authors have reported similar findings (Roberts, Tchanturia, & Treasure, 2010; Shott et al., 2012; Tchanturia et al., 2004). In a study of patients with AN, however, Billingsley-Marshall et al. (2013) found that state anxiety predicted scores on the Ruff Figural Fluency Test ($R^2=.124$) and the COWAT ($R^2=.124$), measures of spatial and verbal set-shifting. Cross-study comparison might be complicated by the difference between state and trait anxiety; Billingsley-Marshall et al. (2013) purposely studied state anxiety, whereas other authors often fail to discuss whether they are attempting to capture state or trait anxiety.

Although the aforementioned studies converge in their conclusion that anxiety is not related to set-shifting in patients with eating disorders, several studies report results indicating such a relationship may exist in healthy populations. Talbot et al. (2014) examined whether set-shifting can be accurately thought of as an endophenotype of AN. They included the Depression Anxiety Stress Scales to capture anxiety, and operationalized set-shifting with the WCST, the Matching Familiar Figures Test, and the Rey Complex Figure Task. Their findings indicated that anxiety was associated with fewer categories achieved in the WCST in the healthy control group ($r = -.34$); this was not found in the patients with AN. However, there was also a negative relationship between anxiety and number of perseverative errors in the healthy control group ($r = -.32$), indicating that increases in anxiety resulted in fewer perseverative errors, underscoring the importance of including multiple aspects of set-shifting. Johnson (2009) examined emotional attention set-shifting in a normal college sample utilizing the State-Trait Anxiety Inventory and a task that required participants to switch between a neutral and an emotional mental set. They found that trait anxiety moderated neutral-to-emotional switch costs, meaning that those participants higher in trait anxiety and worry were less able to switch from a neutral to an emotional set. Notably, emotional attention set-shifting is a different operationalization of set-shifting from that which has previously been discussed in this paper. Nonetheless, this finding emphasizes the importance of considering the multifaceted nature of set-shifting and specificity in defining which aspect of set-shifting will be considered. Taken together, these studies indicate that there are certain circumstances in which a relationship between set-shifting and anxiety can be found.

As was seen in patients with eating disorders and a comorbid anxiety diagnosis, patients diagnosed with eating disorders and comorbid obsessiveness symptoms do not seem to express a

relationship between obsessionality and set-shifting. Danner et al. (2012) used the Yale-Brown Obsessive Compulsive Scale to measure obsessionality in patients with anorexia nervosa and found no significant relationship between the variables of interest ($r = -.06$). Lindner, Fichter, and Quadflieg (2014) used the Maudsley Obsessive Compulsive Inventory and found no significant relationship between obsessionality and set-shifting. However, patients with an OCD diagnosis were explicitly excluded, perhaps causing a restricted range; restricted range on any variable can mask the true nature of the relationship between the variables. Additionally, the investigators only used one measure of set-shifting. This could have caused prevented them from capturing the full nature of the participants' set-shifting abilities; as has previously been seen, varying tasks measuring set-shifting seem to operationalize different components of set-shifting ability. Further studies of obsessionality in patients with eating disorders have failed to find a relationship between these two variables (Roberts, Tchanturia, and Treasure, 2010; Talbot, Hay, Buckett, and Touyz, 2014; Tchanturia et al., 2004).

Contrary to these studies, Holliday et al. (2005) did find a positive correlation between obsessionality as measured by the Maudsley Obsessive Compulsive Inventory and the number of perceptual illusions measured by the Haptic Illusion Task in a sample of patients with AN and their healthy sisters ($r = 0.27, p = .002$). Obsessionality was also positively correlated with total response time on the TMT ($r = 0.26, p = .004$). The inconsistency seems to result from several factors, all of which have also been noted in relation to anxiety, depression, and operationalization of set-shifting. There is inconsistency in the measurement of set-shifting and obsessionality, and the exclusion criteria vary between studies. Additionally, the sample sizes for many of these studies include fewer than 30 participants in each group. Most noteworthy is that

it is once again evident that deficits in set-shifting are not unique to one form of psychopathology and can also be seen in non-clinical samples.

Many of the studies that fail to find a relationship between anxiety and set-shifting, depression and set-shifting, and obsessiveness and set-shifting are those that measure anxiety, depression, and obsessiveness as a comorbid condition in patients with eating disorders. This is an important distinction that might lend support to the idea that set-shifting deficits are a predisposing variable for general psychopathology, rather than one specific disorder. If this is the case, the interpretation of set-shifting as an endophenotype of eating disorders specifically is inappropriate. However, as previously noted, comorbidities in patients with eating disorders are unique in that they can arise from starvation conditions. This makes it less clear whether the anxiety, depression, and obsessiveness seen in patients with eating disorders are truly congruous with the anxiety, depression, and obsessiveness seen in other patients. An understanding of the personality and behavioral correlates of set-shifting ability in a non-clinical population will be useful in helping to determine the nature of the relationships between set-shifting and anxiety, depression, and obsessiveness.

Dietary Restraint

Dieting is considered a significant risk factor for developing an eating disorder (Fairburn, 2005), and it is plausible to hypothesize that some aspects of persistent dieting behaviors are related to set-shifting deficits. Dietary restraint, or the conscious control of caloric intake for weight loss or to prevent weight gain, has been researched extensively. Several authors have argued that dietary restraint can be separated validly into two categories: rigid control and flexible control dieting (Green, Rogers, Elliman, and Gatenby, 1994; Westenhoefer, 1991; Westenhoefer, Stunkard, and Pudel, 1999). Westenhoefer (1991) hypothesized that restrained eaters all attempt to restrict food intake, but use different behavioral strategies for accomplishing

this. His data supported the hypothesis that some employ rigid control techniques, characterized by a dichotomous approach to dieting, while others adopt a less deliberate approach to dieting, termed flexible control. Westenhoefer (1991) explains that these flexible control dieters may count calories, but do not take smaller portions or compensate for eating a “forbidden” food. The attempt for behavioral rigidity found in rigid control dieters might be associated with a deficit in set-shifting. Research has shown that those higher in flexible control dieting differ significantly from those higher in rigid control dieting in depression, eating disorder symptoms, and anxiety (Stewart, Williamson, & White, 2002). Timko and Perone (2005) examined the relationship between the style of dietary restraint, body mass index, and disinhibition. They reported that women with high rigid control tended to have higher BMI and higher disinhibition, with the reverse relationship for those women high in flexible control. In men, however, flexible control was not related to BMI or disinhibition, although rigid control was still associated with high BMI and high disinhibition. Green, Rogers, and Elliman (1994) examined cognitive differences between restrained nondieters, current dieters, and non-restrained nondieters. They found that restrained nondieters did not differ from non-restrained nondieters in measures of vigilance, reaction time, or immediate memory. However, they did not examine restraint subtypes or set-shifting in particular. As yet, no studies have examined the relationship between rigid or flexible control dieting and set-shifting. Given the characterization of rigid control and flexible control dieting, it seems likely that these constructs may be related to general cognitive flexibility, as characterized by set-shifting.

Perfectionism and Set-Shifting

Perfectionism is often clinically associated with the same type of rigidity that is thought to reflect deficits in set-shifting ability. Flett and Hewitt (2006) define perfectionism as a strong need for achievement. They distinguish between positive and negative perfectionism, noting that

high levels of organization, high personal standards, and self-oriented perfectionism are characteristic of positive perfectionism, whereas negative perfectionism is characterized by neuroticism, dissatisfaction, and socially prescribed perfectionism. They articulate the idea that negative perfectionism results from a fear of failure. They also carefully distinguish between conscientiousness and perfectionism: “We believe that the term *perfectionist* should be reserved for those individuals who hold rigidly to their standards, even in situations that do not call for perfection, and who continue to place an irrational importance on the attainment of impossibly high standards in not just one but in several life domains” (p. 476). Using this definition of perfectionism, it can be hypothesized to be associated with the rigidity that is characterized by impaired set-shifting.

One scale commonly used to measure perfectionism is the Frost Multidimensional Perfectionism Scale, which includes six subscales: Concern over Mistakes, Personal Standards, Parental Expectations, Parental Criticism, Doubts about Actions, and Organization (Stober, 1998). Within these subscales, the differentiation between positive and negative, or adaptive and maladaptive, perfectionism can be seen (Lindner, Fichter, and Quadflieg, 2014). When studies examining set-shifting use this scale to capture perfectionism, they often report an overall score and correlate this overall score with set-shifting. Individual subscale scores, however, should yield a better understanding of the relationship between set-shifting and specific components of perfectionism. One of the few studies to report both overall and subscale scores on perfectionism in a sample of patients with eating disorders was conducted by Lindner, Fichter, and Quadflieg (2014). They used the WCST to measure set-shifting, and found that the categories achieved on this task had a significant positive association with overall perfectionism in participants who had recovered from AN ($r=.21, p<.05$); however, this index was negatively correlated with overall

perfectionism in the healthy control group ($r = -0.21, p < .05$). In the healthy control group, overall perfectionism showed a significant positive relationship with the number of perseverations ($r = 0.29, p < .01$); in the recovered patient group, there was a significant negative relationship between perfectionism and the number of perseverations ($r = -0.23, p < .05$). Thus, recovered AN patients with higher overall perfectionism achieved more categories and made fewer perseverations, whereas in healthy control participants, perfectionism was associated with fewer categories achieved and more perseveration. The Parental Expectations subscale was associated with the measures of set-shifting (categories achieved: $r = -0.21, p < .05$; perseverations: $r = .25, p < .05$; shift cost: $r = -0.21, p < .05$) in the control group, but did not correlate with set-shifting in the recovered group. The Personal Standards subscale was strongly associated with set-shifting in the recovered patient group (categories achieved: $r = 0.28, p < .05$; perseverations: $r = -0.25, p < .05$; shift cost: $r = 0.33, p < .01$). Concern Over Mistakes and Doubts about Actions were significantly associated with set-shifting in both groups, but in opposite directions. These differences are, perhaps, the opposite of what one might expect, as perfectionism is generally thought to be maladaptive in psychopathology. It seems possible that the recovered patient group might have displayed a different profile from the healthy control group because of treatment. Perhaps treatment addressed some of the negative aspects of perfectionism, and thus changed the nature of the perfectionism and set-shifting relationship for these patients. Unfortunately, no other study was found that gave a detailed profile of perfectionism and set-shifting in currently ill patients. Future studies should attempt to capture the components of perfectionism to provide a better understanding of how these facets are connected to set-shifting in both clinical and non-clinical samples.

Several studies have failed to find a relationship between set-shifting and perfectionism in samples of patients with eating disorders; this may genuinely reflect an absence of relationship between set-shifting and perfectionism, but methodological choices in these studies may have also affected their results. Abbate-Daga et al. (2014) compared patients with AN to healthy controls using the perfectionism subscale of the Eating Disorders Inventory and the WCST. They dichotomized set-shifting within the patient group, and found that both patients with intact and those with poor set-shifting had higher levels of perfectionism than healthy controls. However, there was no difference in perfectionism between the intact and poor set-shifting patient groups. Yet, when the authors dichotomized the set-shifting variable, they could have lost variability and thus diminished the capability of seeing the relationship between set-shifting and other variables. Similarly, Roberts, Tchanturia, and Treasure (2010) dichotomized set-shifting in a study comparing patients with AN or BN, women recovered from AN, unaffected sisters of women with AN and BN, and a healthy control group. They did, however, report a small effect size (Cohen's $d=0.21$) indicating that as perfectionism increases, set-shifting decreases. The authors do not discuss the possible reasons why this effect size might have failed to reach statistical significance; again, this may reflect a true absence of relationship between perfectionism and set-shifting, or it may be due to study design. They do have a large sample size, but perhaps the dichotomization of set-shifting reduced the variability and prevented the differences between the intact and poor set-shifting groups from reaching statistical significance. We see an inconsistent picture of the relationship between set-shifting and perfectionism, possibly due to methodological choices, including artificial dichotomization and choices in operationalization, or perhaps due to differences in the relationship in varying populations.

Emotion Regulation

Although there have been few studies examining the relationship between emotion regulation and set-shifting, studies that have examined these variables do tend to report a relationship. Cognitive reappraisal is one emotion regulation strategy that entails changing the meaning of an emotional situation to elicit a different emotional response (McRae, Jacobs, Ray, John, and Gross, 2012). This could be related to set-shifting in that those who find it difficult to think flexibly may have a harder time reappraising the meaning of a stimulus. McRae, Jacobs, Ray, John, and Gross (2012) assessed set-shifting in a community sample. The authors used a global/local task in which participants were shown a series of large letters composed of smaller letters. The color of the large letter would cue the participant which letter to attend to, with some trials characterized by non-switching and others characterized by switching. They operationalized emotion regulation using the Emotion Regulation Questionnaire, and were interested in the use of cognitive reappraisal specifically. They found a small positive correlation ($r=0.23$) between reappraisal and set-shifting cost, indicating that those participants who used reappraisal strategies tended to take longer to shift set, and interpreted this finding as evidence of an overall more cautious strategy in response. At present, data on a possible relationship between set-shifting and emotion regulation remain scant.

Systemizing and Set-Shifting

Systemizing is defined as the desire to construct a system that follows rules; these systems can be technical, natural, abstract, motoric, taxonomic, or social (Lawson, Baron-Cohen, and Wheelwright, 2004; Wakabayashi, Sasaki and Ogawa, 2012). Lawson, Baron-Cohen, and Wheelwright (2004) further explain that emotions and mental states are largely irrelevant to these systems. Through these systems, it becomes possible to predict the behavior of the variables involved. Although there have yet to be studies examining the link between

systemizing and set-shifting in a healthy population, the two variables seem likely to be related; the paucity of research examining whether there is a link between set-shifting and systemizing is surprising. One could imagine that individuals higher in systemizing would be resistant to unexpected rule changes. Perhaps research has not been conducted in this particular area because this is a characteristic that is not necessarily dysfunctional. In career paths like science and mathematics, this sort of systemizing tendency can be advantageous. However, the same can be said of perfectionism, making it more difficult to understand why research on the relationship between set-shifting and systemizing has not been conducted.

Some evidence relevant to a putative relationship between systematizing and set-shifting can be found in studies examining the neurological profile of patients with autism spectrum disorders. Spek (2011) examined local information processing in participants with Asperger's syndrome, participants with high-functioning autism, and a neurotypical control group. They did not find any differences between the groups in neuropsychological performance, nor did they find any correlations between the self-report measures of systemizing and the neuropsychological tasks, but they did not include a task specific to set-shifting. Rinehart, Bradshaw, Moss, Brereton, and Tonge (2001) specifically investigated the ability to switch from local to global processing in patients with high-functioning autism and Asperger's, and found deficits in shifting ability in patients with high-functioning autism. Further studies have provided evidence for a deficit in set-shifting in patients with high-functioning autism (Hughes, Russell, & Robbins, 1994; Kaland, Smith, & Mortensen, 2007), but further research is needed to demonstrate whether there is a relationship between systemizing and set-shifting.

Hypotheses

Exploration of the personality and behavioral traits associated with set-shifting in a college-student sample will aid in our understanding of set-shifting in general. This study will

examine the nature of the relationship between set-shifting and depression, anxiety, perfectionism, obsessionality, dietary control, emotion regulation, systemizing, and self-reported cognitive flexibility. Despite a lack of research on set-shifting in a normal population, studies of clinical populations provide some data from which to draw hypotheses. Depression, obsessionality, rigid dietary control, and systemizing are predicted to be negatively correlated with set-shifting ability, such that increases in these variables are associated with deficits in set-shifting ability. Additionally, dimensions of perfectionism representing parental expectations, doubts over actions, concerns over mistakes, and parental criticism are expected to be associated with deficits in set-shifting. The personal standards and organization dimensions of perfectionism, however, are expected to be positively associated with set-shifting ability. Anxiety is hypothesized to have no relationship with set-shifting. Cognitive reappraisal as an emotion regulation strategy is expected to be associated with longer times to shift set, but more accuracy in shifting set. There is expected to be no significant relationship between self-report measures of cognitive flexibility and general set-shifting ability. Further analysis will examine whether there are any gender differences in set-shifting ability, and whether gender moderates any of the relationships between set-shifting and the aforementioned variables. Not enough previous research has been conducted on possible gender differences to allow a base from which draw hypotheses, making this analysis purely exploratory.

Methods

Participant Recruitment

Participants for this study were recruited through the University of Hawai‘i at Mānoa. All students enrolled in introductory psychology classes had the option to participate in research on campus for credit towards their grade; this study appeared as one of their options. Additionally, short presentations on this research were given to undergraduate level courses, many of which provided extra-credit opportunities for research participation. Once recruited, participants met with a research assistant or the principal investigator to review the informed consent document. Regulatory approval was obtained through the University of Hawai‘i at Mānoa’s IRB.

Participants

For the purpose of obtaining a representative sample of college students, inclusion and exclusion criteria were limited. To be considered eligible for the study, participants were required to speak English fluently and be between 18 to 40 years of age. There is mixed evidence for a decline in set-shifting ability in older adults. Few older adults were expected to be recruited, eliminating the possibility of having enough variance to include age as a variable; thus, including older adults would have only added to individual variability. This age range was also selected to be inclusive and representative of the typical age range seen at the University of Hawai‘i at Mānoa. Although participants were asked whether they currently had a diagnosis of or were being treated for an eating disorder, obsessive compulsive disorder, or severe depression (see Appendix A), those who respond affirmatively were not excluded. The goal of this study was to examine the correlates of set-shifting in a general college population, which includes individuals with psychological disorders.

Procedures

Participants signed up to participate through the University's research organization tool, Sona. After reviewing and signing the consent forms, all participants first completed the self-report measures not relating to cognitive flexibility online. Once scheduled for the neuropsychological assessment, half of the participants completed the self-report cognitive flexibility assessments first and half completed the neuropsychological measures first. It was unclear whether completing the neuropsychological set-shifting tasks might impact self-report on cognitive flexibility, and this design choice made it possible to examine whether such an effect might have been present. The self-report assessments were computer-based. The principal investigator or a trained research assistant administered all neuropsychological tasks in a standard order.

Measures

Demographics. Participants were asked to report their age, gender, years of education completed, and race. Response options for race can be found in Appendix A. The participants were also asked whether they had been diagnosed with or were receiving treatment for an eating disorder, depression, or obsessive-compulsive disorder. The demographic questionnaire can be found in Appendix A.

Cognitive Flexibility Inventory (CFI) (Dennis & Vander Wal, 2010). Dennis and Vander Wal's (2010) CFI was developed to measure components of cognitive flexibility that allow individuals to think adaptively in response to stressful life events. They hypothesized that three components contribute to this ability: "(a) the tendency to perceive difficult situations as controllable; (b) the ability to perceive multiple alternative explanations for life occurrences and human behavior; and (c) the ability to generate multiple alternative solutions to difficult

situations” (p. 243). Conceptually, this can be thought of as similar to mental flexibility. This scale is unlikely, however, to be representative of perseverative errors. The items are presented as declarative statements, and respondents indicate their degree of agreement with a 7-point Likert scale response.

Dennis and Vander Wal (2010) tested the CFI’s reliability and validity in a sample of 196 undergraduates from a private Midwestern university. The 20 items load onto two factors: an alternatives subscale and a control subscale. Both subscales showed adequate Cronbach’s alpha (Alternatives: Time 1=0.91, Time 2=0.91; Control: Time 1=0.86, Time 2=0.84). The measure also had high 7-week test retest reliability ($r=0.81, p<.001$). Convergent validity was documented through correlations with the Cognitive Flexibility Scale (CFS) at time 1 ($r=.73, p<.001$) and time 2 ($r=.75, p<.001$). Convergent validity was also supported through examining correlations between the CFI and a measure of adaptive coping; at both time 1 and 2, small to medium correlations were found between the CFI and problem-focused coping ($r=.48$ and $.49, p<.001$), seeking social support ($r=.32$ and $.32, p<.001$), and focusing on the positive ($r=.39$ and $.32, p<.001$). The authors also present support for concurrent validity through correlations with the Beck Depression Inventory-2 ($r = -.39, p<.001$), with greater cognitive rigidity on the CFI associated with higher scores on the BDI-2. Johnco, Wuthrich, and Rapee (2014) demonstrated small correlations between the CFI and certain neuropsychological tasks in a sample of geriatric patients (TMT-B: $r=.306, p<.01$; WCST perseverative errors: $r=.227, p<.05$; Controlled Oral Word Association Test [COWAT]: $r=.411, p<.001$; Stroop: $r=.430, p<.001$).

Additional Cognitive Flexibility Questions. Several questions were added to the CFI in an attempt to operationalize cognitive flexibility as it was measured by the neuropsychological

tasks; these questions were predicted to be more highly associated with the neuropsychological outcomes utilized in this study. They were intended to reflect ability to perceive rules and adapt to changes in those rules; this is closely related to what was expected of patients completing the WCST and the Brixton task. In this way, we could examine whether participants were insightful about these abilities specifically. Participants used the same 7-point Likert response scale as was used on the CFI. These included the following questions:

- I have noticed that I easily pick up a rule for how something should be done.
- When the rules change, I'm not always quick to change.
- I persist in using rules for thinking about or categorizing something, despite feedback that it might not be correct.
- I have an easy time changing tasks quickly.

Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983). Zigmond and Smith (1983) designed the 14-item HADS to detect anxiety and depression in patients in non-psychiatric hospital settings. Although the present sample did not include medical patients, this scale was appropriate in that it was designed for patients who do not have an existing psychiatric diagnosis. In initial validation of the scale, Zigmond and Snaith (1983) assessed 50 patients and obtained two factors: anxiety and depression. Additionally, they sampled 100 patients to determine the accuracy of the scale in detecting anxiety and depression; for the depression subscale, the rate of both false positives and false negatives was 1%; for the anxiety scale, the false positive rate was 5% and the false negative rate was 1%.

Bjelland, Dahl, Haug, and Neckelmann (2002) conducted a literature review to consider the current validity and reliability of the HADS. They found that the correlations between the

two factors (HADS-A and HADS-D) varied from .40 to .76. The high correlation is, perhaps, not surprising given the high comorbidity between anxiety and depression. Across studies, HADS-A was found to have adequate internal consistency (Cronbach's alpha between .68-.93), as was HADS-D (Cronbach's alpha between .67-.90). Sensitivity and specificity when using a cutoff of 8+ were in the range of 0.70 to 0.90. When correlated with other common measures of anxiety and depression, such as the Beck Depression Inventory, the State Trait Anxiety Inventory, and the SCL-90 Anxiety and Depression subscales, the correlations were between .60 and .80. Bjelland et al. (2002) concluded that the scale performs well in assessing anxiety and depression in somatic, psychiatric, and primary care patients, and in the general population.

Beck Depression Inventory, second edition (BDI-2) (Beck, Steer, & Brown, 1996). The BDI and the BDI-2 were designed to measure the presence and severity of depression in patients with a psychiatric diagnosis, as well as in normal populations of adolescents and adults (Dozois, Dobson, & Ahnberg, 1998). The BDI-2 is a 21-item scale, with each response rated on a four-point scale. It has demonstrated high internal consistency ($\alpha=.93$ in college students, $\alpha=.92$ among outpatients) (Beck, Steer, & Brown, 1996), and significant association with the original BDI ($r=.93$, $p<.01$) (Dozois, Dobson, & Ahnberg, 1998). Beck, Steer, and Brown (1996) also demonstrated high test-retest reliability ($r=.93$), and convergent validity with the Hamilton Depression Rating Scale ($r=.71$) in a clinical population.

State-Trait Anxiety Inventory (STAI) (Spielberger, Lushene, Vagg, & Jacobs, 1983). The STAI is intended to capture both fleeting, momentary anxiety and a general tendency toward anxiety. It includes 20 items focusing on how individuals feel in the current moment, as well as

20 items regarding how they generally feel. For both subscales, participants rate how they are feeling on a four point Likert scale, ranging from “not at all” to “very much so” for the state items and “almost never” to “almost always” for the trait items. Internal consistency ranged from .83 to .92 for high school and college students on the state score; for the trait score, internal consistency ranged from .86 to .92 (Spielberger, Lushene, Vagg, & Jacobs, 1983). The test-retest coefficients were high for the trait scale (.84 for men, .76 for women), and low for the state scale (.33 for men, .16 for women), for which relatively low test-retest reliability would be expected (Spielberger, Lushene, Vagg, & Jacobs, 1983). In an analysis of the reliability of the STAI across studies utilizing the instrument, Barnes, Harp, and Jung (2002) reported an average internal consistency for the state scale of .91, and an average test-retest reliability of .70. For the trait scale, the average internal consistency score was .89, and the average test-retest reliability was .88.

Maudsley Obsessive-Compulsive Inventory (MOCI) (Hodgson & Rachman, 1977). Hodgson and Rachman (1977) developed the MOCI as a means of quantifying types of obsessional behavior. The 30-item true-false scale represents four components: checking, cleaning, slowness, and doubting. The internal consistency of these scales, respectively, are 0.7, 0.8, 0.7, and 0.7; one-month test-retest reliability was high (Kendall’s tau = 0.8) in a sample of patients with OCD and a matched control group (Hodgson & Rachman, 1977). Sternberger and Burns (1990) examined the psychometric properties of the MOCI in a sample of college students; this was the first study to establish nonclinical norms for the MOCI. They found adequate internal consistency and test-retest reliability ($\alpha=.75$; $r=.69$, $p<.001$). They also demonstrated convergent

validity with the Obsessive-Compulsive Scale of the Symptoms Checklist-90-Revised (SCL-90-R) ($r=.51$).

Frost Multidimensional Perfectionism Scale (FMPS) (Frost, Marten, Lahart, & Rosenblate, 1990). Frost, Marten, Lahart, and Rosenblate (1990) developed the FMPS as a means of measuring multiple dimensions conceptually relevant to perfectionism. At that time, several scales measuring perfectionism existed, but none accessed the complex nature of the construct. This 35-item scale yields 6 factors, accounting for 54% of the variance in the original sample of undergraduate females used for scale development (Frost et al., 1990). The factors include: Concern over Mistakes, Personal Standards, Parental Expectations, Parental Criticism, Doubts about Actions, and Organization. Internal consistencies for the subscales range from .77 to .93, and Cronbach's alpha for the total scale was .90 (Frost et al., 1990). They also established convergent validity among subscales of the FMPS and several other perfectionism measures. The Burns Perfectionism Scale was highly correlated with the Concerns Over Mistakes subscale ($r=.87$) and moderately correlated with the Personal Standards ($r=.53$), Parental Expectations ($r=.43$), Parental Criticism ($r=.42$), and Doubts About Actions ($r=.47$) subscales (Frost et al., 1990). The Perfectionism Scale from the Eating Disorder Inventory was also moderately correlated with the Concerns Over Mistakes ($r=.57$), Personal Standards ($r=.44$), Parental Expectations ($r=.36$), and Doubts About Actions ($r=.34$) subscales (Frost et al., 1990).

Emotion Regulation Questionnaire (ERQ) (Gross & John, 2003). The ERQ was intended to evaluate two emotion regulation strategies: cognitive reappraisal and expressive suppression. Gross and John (2003) conceptualize cognitive reappraisal as “a form of cognitive change that

involves construing a potentially emotion-eliciting situation in a way that changes its emotional impact” (p. 349). Expressive suppression, then, is the active inhibition of emotion-expressing behavior. The final scale includes 10 items, and responses are given on a 7-point Likert scale ranging from “strongly disagree” to “strongly agree.” The reappraisal and suppression factors were supported in factor analysis, and test-retest reliability across 3 months was .69 for both scales in a sample of undergraduate students (Gross & John, 2003). In a second study using the same sample of undergraduate students, Gross and John (2003) establish convergent validity between reappraisal and a scale measuring coping through reinterpretation ($\beta=.43$).

Rigid vs. Flexible Dieting Scale (Westenhoefer, Stunkard, & Pudel, 1999). These scales were derived from the Cognitive Restraint scale of the Eating Inventory, and include 16 items measuring rigid control of eating (RC-16) and 12 items measuring flexible control of eating (FC-12). Westenhoefer, Stunkard, and Pudel (1999) established internal consistency of 0.70 to 0.77 for the Rigid Control subscale, and 0.69 to 0.79 for the Flexible Control scale in a random sample of subjects living in private households. Timko and Perone (2005) established convergent validity between the rigid control scale and several measures of eating disorder behavior, as well as a cognitive restraint scale in a sample of undergraduate men and women.

Systemizing Quotient (SQ) (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003). The SQ was developed in response to the need for a self-report measure that captures systemizing, or the understanding of rules and how systems are organized (Baron-Cohen et al., 2003); Ling, Burton, Salt, and Muncer (2009) assessed the psychometric properties of this scale in a sample of undergraduate students from several universities. They reported a Cronbach’s

alpha of .80, and determined that SQ loads onto four factors: topography (map reading), technicity (an interest in technical information), DIY, and structure (an interest in the structure of things). Nettle (2007) established convergent validity between the SQ and interest in fields that require particular attention to rules and systems, such as technology, computers, and science.

Eating Attitudes Test-26 (EAT-26) (Garner, Olmsted, Bohr, & Garfinkel, 1982). The EAT-40 was originally designed as a self-report measure of the symptoms of anorexia nervosa, and has been shown to be useful in identifying undiagnosed cases of anorexia nervosa, as well as groups of people with significant eating and weight concerns. The EAT-26 is a shortened version based on a factor analysis (Garner, Olmsted, Bohr & Garfinkel, 1982). Garner, Olmsted, Bohr, and Garfinkel's (1982) sample of women with AN and control patients yielded three factors from the EAT-40: dieting, bulimia and food preoccupation, oral control. Fourteen items did not load onto any factor and were eliminated. The authors also established convergent validity with body-image variables. Garner and Garfinkel (1979) reported high internal consistency for the EAT-40 ($\alpha=0.94$) in patients with AN and control patients. Garfinkel and Newman (2007) reviewed the literature and found that the EAT had high test-retest reliability, and converged with other measures of eating disorder symptomatology.

International Personality Item Pool (IPIP) (Goldberg et al., 2006). The IPIP item pool was developed as a means of providing measures of personality within the public domain. The development of these scales began in 1996 at the eighth European Conference on Personality and the scales have continued to grow since that time. The IPIP scales are continually refined through collaborative mechanisms, with the hope that progress would occur more rapidly by pooling

international personality researchers together. Each of the scales was constructed by correlating the items with the original Five Factor inventory scales. The items were then rank-ordered based on the size of the correlations to determine which scale the item should belong to, thus ensuring that the items selected for each scale correlated most highly with that scale. Further description of scale development is found in Goldberg et al. (2006). The items include short phrases (i.e., “I am quiet around strangers”) and respondents are asked to judge how applicable these statements are to themselves. The authors’ intention was to provide enough context within the short phrase such that different interpretations of the statements were limited. The items and scales chosen for this survey are proxies for the Big Five Factors: Emotional Stability, Extraversion, Intellect, Agreeableness, and Conscientiousness; each factor has a 10-item scale. Responses are based on a 5-point system ranging from very inaccurate to very accurate; responses are given a numerical assignment and then summed. Notably, the IPIP scales do not provide norms; this is a purposeful decision from one of the key authors. Examinations of the IPIP 50-item inventory have generally supported the five-factor structure for use in healthy young adult samples (Ehrhart, Roesch, Ehrhart, & Kilian, 2008; Guenole & Chernyshenko, 2005).

Wisconsin Card Sorting Task-64-Computerized Version (WCST-64-CV). (Heaton, 1993).

The WCST-64-CV is a computerized and shortened version of the original WCST 128-card version. Because it maintains the basic requirements of the 128-card task, much of the literature focusing on the original task applies to the shortened version (Heaton, 1993). The task consists of four stimulus cards and 64 response cards. The stimulus cards display one red triangle, two green stars, three yellow crosses, and four blue circles; thus, there are three sorting parameters: color, shape, and number. Each response card displays varying shapes, colors, and numbers of

figures, and can be matched to the stimulus cards based on the three parameters. The participant must determine which sorting rule the computer is using based on feedback provided after each sort; the computer flashes either the word “Incorrect” or “Correct.” Based on this feedback, the participant must determine the computer’s sorting rule. After the participant has made 10 consecutive correct matches, the computer changes the sorting rule without any indication to the participant. The participant must then discontinue the previous sorting rule and determine the new one. The participant is not told in the instructions that the sorting rule will change, but this should be deciphered based on the feedback provided during the task. This procedure continues for all 64 response cards. Possible outcome scores include the number of categories completed, the number of errors, the number of perseverations, the number of trials needed to complete the first category, consistency in maintaining a response set, and learning efficiency. This study used the following outcomes: number of categories completed, number of perseverations, and number of trials needed to complete the first category. These outcome measures specifically targeted perseveration and ability to learn new rules.

The WCST was developed as a measure of flexible thinking and abstract reasoning ability in normal adults (Heaton, 1993). Research originally suggested that the WCST is particularly sensitive to frontal lobe dysfunction (Heaton, 1993). Recent studies have indicated that it involves diffuse brain areas (Lie, Specht, Marshall, & Fink, 2006), which is unsurprising in view of our current understanding of the interconnected nature of brain circuitry. Lie, Specht, Marshall, and Fink (2006)’s analysis of the neural circuitry involved in the task indicated that brain areas associated with working memory were also activated in a sample of healthy volunteers. Given that participants are asked to hold the previous sorting rule while sorting the current card, the involvement of working memory would be expected. Despite the involvement

of other neural processes, the WCST does activate set-shifting circuitry and remains a task frequently used to operationalize this ability (Lie, Specht, Marshall, & Fink, 2006). Test-retest reliability of 0.64 was reported by Ingram, Greve, Ingram, and Soukup (1999) in their sample of sleep apnea patients. Although previous test-retest reliabilities have been lower, this might be expected due to the nature of the test. Once an individual has completed the WCST, he or she is aware that the rule will change during the task. This likely changes the nature of what is being measured.

Trail Making Test, Part B. (TMT-B) (Reitan, 1958). The Trail Making Test consists of two components: Part A (TMT-A) and Part B (TMT-B). The task for TMT-A requires participants to draw a line connecting numbers in order (i.e., 1-2-3, etc.); the numbers are jumbled throughout the page. The primary outcome measure is time to completion. TMT-A measures several cognitive processes, including working memory, motor skills, and a visual perceptual ability. TMT-B includes numbers and letters scattered throughout a page. Participants are asked to draw a line alternating between numbers and letters in sequential order (i.e., 1-A-2-B-3-C, etc). The primary outcome is the time to completion for this task compared to the time to complete part A. The primary difference between parts A and B is that part B requires cognitive flexibility; thus, comparing the time for part B to part A gives an estimate of set-shifting ability (Kortte, Horner, & Windham, 2002). This test specifically captured the ability to alternate flexibly and quickly between mental sets.

Several studies have established the validity of the TMT-B as a measure of cognitive flexibility. In a sample of veterans referred for neuropsychological evaluation, Kortte, Horner, and Windham (2002) conducted an analysis to establish that, aside from time on Part A, the

variable that accounts for the most variance in Part B was a measure of cognitive flexibility (R^2 change= 0.07, $p<.001$). In their comparison of the TMT-B to a classic set-switching task, Arbuthnott and Frank (2002) found that, in a sample of undergraduate students, the TMT-B was highly correlated with switch-cost in their set-switching tasks. The scores on the set-shifting task were particularly correlated with the B/A ratio. Similarly, Sanchez-Cubillo et al. (2009)'s analysis of the TMT in healthy patients found that the B/A ratio minimized the influence of visuo-perceptual and working memory demands and provided a purer index of executive control. As is true of many neuropsychological tasks, the TMT is susceptible to practice effects. However, at longer time intervals, test-retest reliability does not appear to be as impacted by these effects (Bowie & Harvey, 2006).

Brixton Spatial Anticipation Test (Burgess & Shallice, 1997). The Brixton Spatial Anticipation Test measures the ability of participants to detect and follow a rule, and then to detect and follow a new rule. It has no time restriction, and takes approximately 10 minutes to administer (van den Berg et al., 2009). Participants are presented with a 56-page stimulus booklet; each page of the booklet contains an array of 10 circles numbered 1 to 10. On each page, one circle is blue, and the position of the blue circle changes on subsequent pages. These changes follow a specific rule, and the rule changes periodically without warning. Participants are asked to predict the movement of the blue circle. The total number of errors across all trials is used as the outcome measure (maximum score=55) (van den Berg et al., 2009). This was included in the current study as a second measure of perseveration and ability to learn rules. In van den Berg et al.'s (2009) analysis of the Brixton task as a measure of executive function, it was determined that the test was able to discriminate between patients with executive dysfunction (group consisting of

patients with Korsakoff's syndrome, stroke, and psychiatric disorders) and those without cognitive dysfunction (healthy controls and patients with diabetes mellitus). Additionally, the test was further able to differentiate between patients with Korsakoff's syndrome, which is generally considered to produce significant impairment, and those with stroke and psychiatric disorders. The authors interpret this as indicative of the Brixton test's sensitivity to subtle impairments. Further, their analysis indicated that the test loaded with the TMT-B in their neuropsychological battery; this was taken to mean that the two tasks composed a mental flexibility factor. Test-retest correlation was reported by Burgess and Shallice (1997) ($r=0.71$), and van den Berg et al. (2009) ($r=0.61$). Although not as high as might be preferable, many neuropsychological tasks have marked learning effects that impact test-retest correlations.

Statistical Analyses

Pearson correlation coefficients were used to examine the relationship between each set-shifting outcome (WCST: number of categories completed, number of perseverations, and number of trials needed to complete the first category; Brixton: total number of errors; TMT: B/A completion time ratio) and depression, anxiety, obsessionality, perfectionism, dietary restraint, emotion regulation, and systematizing. Based on previous literature, correlations between set-shifting and depression, obsessionality, perfectionism, and emotion regulation were expected to be small ($r=0.2$). In order to achieve 80% power for a two-tailed test, G*Power 3.1 indicated that a total sample size of 193 participants would be needed. Due to the deficit in prior research on the relationship between set-shifting and dietary restraint, as well as set-shifting and systematizing, this analysis was purely exploratory. Pearson correlation coefficients were also used to examine the relationship between the neuropsychological tasks and the self-report measure of cognitive flexibility.

A MANOVA was used to detect any gender differences in set-shifting ability; with each set-shifting outcome included as a dependent variable. With a two-tailed test for a medium effect size, 64 participants were needed in each group to detect group differences. If significant, it was planned that linear regression would be used to determine the contribution of each independent variable to variance in set-shifting ability, and to determine whether gender moderated the relationship between set-shifting and depression, anxiety, obsessiveness, perfectionism, dietary restraint, emotion regulation, and systematizing. The regression analyses would be run separately for each variable using Process for SPSS v2.13. Given the exploratory nature of this analysis, power analyses were based on a medium effect size ($f^2=0.15$). To achieve 80% power to detect gender differences, the total sample size required would be 68 participants. Given the higher number of participants required to detect the predicted small correlations, the recruitment for this study was 194 participants total. Although it would be ideal to have included an equal number of men and women, it was not possible to recruit 97 men. We allowed for a greater number of female participants, with a minimum of 64 male participants.

Specific Hypotheses:

1. WCST number of perseverations, number of trials needed to complete the first category, and Brixton number of errors were expected to be positively correlated with the BDI-2, HADS-depression, MOCI, RC-16, the SQ, and Emotional Stability from the IPIP. They were also expected to be positively correlated with the Parental Expectations, Doubts over Actions, Concern over Mistakes, and Parental Criticism of the FMPS. It was hypothesized that they would be negatively correlated with Personal Standards and Organization scales from the FMPS, the FC-12, the ERQ—cognitive reappraisal score, and Intellect from the IPIP. They were not expected to be significantly correlated with the

HADS-anxiety, the STAI, the CFI, or the Agreeableness, Extraversion, or Conscientiousness scales of the IPIP.

2. TMT-B was expected to have similar relationships as above to anxiety, depression, obsessionality, dietary restraint, systemizing, perfectionism, and self-reported cognitive flexibility, and the Big Five personality factors. However, it was expected that the TMT-B will have a negative relationship with ERQ—cognitive reappraisal scale.
3. WCST total number of categories achieved was hypothesized to be positively correlated with the Personal Standards and Organization scales from the FMPS, the FC-12, the ERQ—cognitive reappraisal scale, and Intellect from the IPIP. It was hypothesized to be negatively related to the BDI-2, HADS-depression, MOCI, RC-16, the SQ, and Emotional Stability from the IPIP. It was also expected to be negatively correlated with the Parental Expectations, Doubts over Actions, Concern over Mistakes, and Parental Criticism scales of the FMPS. It was not expected to be significantly correlated with the HADS-anxiety, the STAI, the CFI, or the Agreeableness, Extraversion, or Conscientiousness scales of the IPIP.
4. As previously indicated, the analyses regarding the impact of gender on these relationships was purely exploratory. As such, no specific hypotheses were made.

Results

Missing data. Participants were recruited through the undergraduate psychology program at the University of Hawai‘i at Mānoa. Students enrolled in psychology courses were offered class credit or extra credit for participation in research studies during the semester. In total, 257 students completed the online surveys. All were contacted to schedule the in-person assessment and 195 (75.9%) followed the study through to completion. When comparing study completers to non-completers using independent sample t-tests, non-completers scored significantly higher on the HADS depression scale ($t(255) = 2.61, p = .01$) and significantly lower on the ERQ Reappraisal scale ($t(255) = -2.79, p = .006$). Non-completers also scored significantly lower on the IPIP Agreeableness ($t(255) = -3.75, p < .001$), IPIP Conscientiousness ($t(255) = -2.67, p = .008$), and IPIP Intellect scales ($t(255) = -3.37, p = .001$). It is reasonable to hypothesize that increased depressive symptomatology and lower agreeableness, conscientiousness, and curiosity would impact students' willingness to spend additional time participating in research. Group differences on emotional reappraisal are more difficult to interpret, but may be a byproduct of the negative association between the HADS Depression and the ERQ Reappraisal scores ($r = -.25, p < .001$), such that increases in depressive symptomatology are related to decreases in emotional reappraisal and account for group differences on this variable.

A portion of participants who completed the in-person assessment failed to answer every item, resulting in some missing data points (<1% of all data points). When considered appropriate based on literature review, alternative scoring methods were utilized so as to include as much data as possible. One individual had 1 missing data point for the BDI. This individual was included in analyses with the score adjusted for the missing data (sum divided by the number of completed items, multiplied by 21) (Dolle et al., 2012). Five individuals had 1 missing data point on the EAT-26 and the median of the scale was imputed into these missing

data points (Garner, Olmstead, Bohr, & Garfinkel, 1982). Three participants had 1 missing data point on the IPIP and this was resolved through imputation of the median value (Goldberg et al., 2006). Only complete questionnaires were used for the STAI, MOCI, FMPS, ERQ, FC-12, RC-16, and SQ. This resulted in 0.01% to 2.5% missing data across scales. Additionally, the computer utilized to administer the WCST malfunctioned on two separate occasions, resulting in incomplete assessment for two participants. These participants' other neuropsychological measures were included in final analyses.

All self-report measures, with the exception of the EAT (skewness = 2.05, kurtosis = 4.91), were within standard bounds of normality (skewness < 1.00, kurtosis < 2.00). Several of the neuropsychological measures were heavily kurtotic, as seen in Table 1. After removing 4 univariate outliers, the variables were closer to normal (see Table 1). Although the WCST “trials to complete the 1st category” remained kurtotic, this variable was included in final analyses because general linear models are considered fairly robust to violations of normality when the sample size is large (Warner, 2013). This resulted in a final data set with 191 participants (71 males, 120 females). Additionally, a log transformation was used for the outcome variable on the TMT (i.e., ratio of time to complete part B to time to complete part A). This transformation brought the measure within normal ranges on skewness and kurtosis. All subsequent analyses were run with both the original data and the transformed data, with only minor differences in the size of correlations. Accordingly, the non-transformed results are reported for ease of interpretation.

Table 1. Normality data for variables that exceeded suggested guidelines for skewness and kurtosis.

	<i>With outliers</i>		<i>Without outliers</i>	
	Skewness	Kurtosis	Skewness	Kurtosis
WCST Trials to 1st	6.45	51.48	3.84	16.87
WCST Cat. Comp.	-1.78	4.27	-1.58	3.61
WCST Pers. Err.	3.56	21.79	1.34	1.77
TMT B : A	1.42	3.00	0.27	-0.03

WCST, Wisconsin Card Sorting Test; Cat. Comp., Categories Complete; Pers. Err., Perseverative Errors; TMT B : A, Trail Making Test ratio of time B : time A

Bivariate Correlations

Bivariate correlations between self-report measures and measures of set-shifting are reported in Table 2 (see Appendix A). Poorer set-shifting is thought to be reflected in a greater number of trials needed to complete the first WCST category, fewer WCST categories completed, and a larger number of perseverative errors on the WCST and the Brixton task. Greater difficulty set-shifting is also represented by a larger TMT ratio of time to complete part B to time to complete part A, as this would be indicative of a larger discrepancy between the time needed to complete parts A and B. Further, lower CFI Alternatives and Control scores (i.e., less self-perceived ability to consider multiple solutions or explanations and decreased ability to see difficult situations as controllable) are thought to indicate lesser cognitive flexibility.

Full Sample

Anxiety and set-shifting had an overall negative association, as the HADS-A had small but significant correlations indicating that anxiety was associated with a larger number of trials needed to complete the first WCST category ($r = .15, p = .04$) and fewer WCST categories completed ($r = -.17, p = .02$). Rigid dieting strategies, measured by the RC-16, were similarly negatively linked with set-shifting, as increases in rigid dieting were associated with fewer categories completed ($r = -.16, p = .03$) and more perseverative errors ($r = .17, p = .02$). Parental

expectations and organizational standards were also negatively related to set-shifting, as increases in the FMPS Parental Expectations and Organization subscales were linked with a larger number of perseverative errors on the WCST (Parental Expectations: $r = .18, p = .01$; Organization: $r = .17, p = .02$). Further, eating pathology on the EAT-26 was negatively associated with set-shifting, as increases in eating concerns correlated with fewer categories completed ($r = -.18, p = .01$). There were no significant associations among the number of errors on the Brixton task and the independent variables, nor among the TMT B : A ratio and the independent variables.

The self-report measures of cognitive flexibility showed stronger correlations with the independent variables. Consistent with the neuropsychological measures, anxiety was negatively associated with self-perceived ability to consider multiple solutions or explanations, as measured by the CFI Alternatives subscale (HADS Anxiety: $r = -.26, p < .001$; STAI X1: $r = -.30, p < .001$; STAI X2: $r = -.33, p < .001$). The CFI Alternatives subscale was also positively correlated with the use of emotional reappraisal strategies (ERQ Reappraisal: $r = .24, p = .001$), tendencies towards systemizing (SQ: $r = .40, p < .001$), and personal standards (FMPS Personal Standards: $r = .30, p < .001$). It was negatively related to depression (HADS Depression: $r = -.30, p < .001$; BDI: $r = -.29, p < .001$) and self-doubt (FMPS Doubts about Actions: $r = -.19, p = .009$), highlighting the importance of conceptualizing and measuring perfectionism as a multidimensional construct. Additionally, the CFI Alternatives subscale was positively linked to each dimension of personality (IPIP Extraversion: $r = .39, p < .001$; Agreeableness: $r = .39, p < .001$; Conscientiousness: $r = .21, p = .003$; Emotional Stability: $r = .27, p < .001$; and Intellect: $r = .50, p < .001$). This indicates that participants with poorer self-perceived ability to consider multiple solutions were less likely to enjoy the stimulation of large crowds, more skeptical, less

efficient or organized, more emotionally labile, and had fewer tendencies towards an intellectual or imaginative style.

A consistent pattern was seen with the CFI Alternatives subscale and the CFI Control subscale (see Table 2), such that the relations between the Control subscale and the independent variables were in the same direction as those between the Alternatives subscale and the independent variables. Decreased ability to see situations as controllable (i.e., poorer cognitive flexibility) was negatively associated with anxiety (HADS Anxiety: $r = -.48, p < .001$; STAI X1: $r = -.47, p < .001$; STAI X2: $r = -.56, p < .001$), depression (HADS Depression: $r = -.40, p < .001$; BDI: $r = -.46, p < .001$), and self-doubt (FMPS Doubts about Actions: $r = -.41, p < .001$). This subscale was also positively related use of emotion reappraisal strategies (ERQ Reappraisal: $r = .25, p = .001$), systemizing (SQ: $r = .40, p < .001$), and personal standards (FMPS Personal Standards: $r = .25, p < .001$). Perceived level of control was positively correlated with each domain of personality measured (IPIP Extraversion: $r = .43, p < .001$; Agreeableness: $r = .22, p = .002$; Conscientiousness: $r = .28, p < .001$; Emotional Stability: $r = .46, p < .001$; Intellect: $r = .37, p < .001$). Patterns unique to the CFI Control subscale included its negative relation with the MOCI ($r = -.28, p < .001$), FMPS Concerns about Mistakes ($r = -.30, p < .001$), FMPS Parental Criticisms ($r = -.16, p = .03$), and ERQ Suppression ($r = -.17, p < .02$), indicating that less perceived controllability is linked to an increase in obsessiveness, concerns about mistakes, levels of parental criticism, and emotional suppression.

As indicated in Table 3, the neuropsychological measures showed little to no association with the self-report measure of set-shifting, with all correlations being less than .01. The Brixton, WCST, and TMT further evidenced little relation between each other, with the only significant correlations found between different measures from the WCST. The WCST number

of categories completed was negatively related to the trials to 1st category ($r = -.28, p < .001$), such that increases in the number of trials needed to complete the 1st category were associated with fewer categories completed overall. Additionally, the number of perseverative errors on the WCST was negatively correlated with the number of categories completed ($r = -.40, p < .001$), indicating that increases in perseveration were linked with fewer completed categories.

Table 3. Bivariate correlations among measures of set-shifting.

	CFI Alt	CFI Con	Brixton	WCST Trials to 1 st	WCST C. Comp.	WCST Pers. Errors	TMT B : A
CFI Alt.	1	.63**	-.04	.02	.05	.01	.05
CFI Con.		1	-.03	-.03	.12	-.02	.10
Brixton			1	.05	-.06	.11	.13
WCST Trials 1st				1	-.28**	.02	.003
WCST C. Com.					1	-.40**	-.06
WCST Pers. Err						1	.04
TMT B : A							1

* $p < .05$

** $p < .01$

CFI Alt, Cognitive Flexibility Inventory – Alternatives; CFI Con., Cognitive Flexibility Inventory – Control; Brixton, Brixton total errors; WCST, Wisconsin Card Sorting Test; C. Comp., Categories Completed; Pers. Err., Perseverative Errors; IPIP; TMT B : A, Trail Making Test ratio of time B : time A

The four items added to the CFI Alternatives subscale were significantly positively correlated with the original CFI Alternatives scale ($r = .96, p < .001$). They also showed a similar pattern and strength of associations between the independent variables as was seen with the original CFI Alternatives scale. Therefore, it seems unlikely that the additional items added unique information about self-perceived cognitive flexibility.

High eating pathology

Participants with a total EAT-26 score greater than 19 represent a group with potentially significant eating and weight/shape concerns (Garner, Olmstead, Bohr, & Garfinkel, 1982).

Table 4 presents the means and standard deviations for this group ($n = 27$) and individuals with EAT-26 scores less than 19 ($n = 164$) on the measures of set shifting. The largest differences, while considering variance, appeared to exist on the Brixton task and the number of categories completed on the WCST. As a result, a MANOVA was utilized to determine that at least one of these differences, or the combination of the two, reached statistical significance (Box's $M = .84$, $p = .85$; Wilks $\Lambda = .96$, $F(1, 187)$, $p = .01$) such that participants with elevated eating disorder symptomatology performed significantly worse. Other scales were not included in this MANOVA because of the seemingly small differences between the groups and the underpowered nature of this analysis.

Table 4. Means and standard deviations on measures of set-shifting for the full sample and participants with EAT-26 scores greater than 19.

	EAT-26 < 19		EAT-26 > 19	
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>
CFI Alt.	69.41	8.52	69.56	6.32
CFI Con.	35.70	7.23	33.85	6.04
Brixton	12.02	3.79	13.48	3.32
WCST Trials 1st	11.94	3.21	12.08	2.74
WCST C. Com.	4.42	0.78	4.04	.82
WCST Pers. Err	5.05	1.49	5.27	1.51
TMT B : A	2.64	1.03	2.71	0.98

EAT-26, Eating Attitudes Test 26-item version; CFI Alt, Cognitive Flexibility Inventory – Alternatives; CFI Con., Cognitive Flexibility Inventory – Control; Brixton, Brixton total errors; WCST, Wisconsin Card Sorting Test; C. Comp., Categories Completed; Pers. Err., Perseverative Errors; IPIP; TMT B : A, Trail Making Test ratio of time B : time A

This group was subsequently analyzed separately to determine whether a distinct pattern emerged for participants with higher levels of eating disorder symptomatology (see Table 5, Appendix A). Although fewer statistically significant results were found, this may be due to the small sample size. Despite statistical non-significance, many of the correlations were moderate to large in size.

The neuropsychological measures appeared to have stronger associations with several variables in this group. In this subset of participants, the Brixton task was positively associated with anxiety (HADS Anxiety: $r = .31, p = .12$), depression (HADS Depression: $r = .19, p = .25$), obsessionality (MOCI: $r = .17, p = .40$), organizational standards (FMPS Organization: $r = .31, p = .12$), systemizing (SQ: $r = .18, p = .16$), and conscientiousness (IPIP Conscientiousness: $r = .27, p = .17$), indicating that increases in each of these variables was related to a greater number of errors on the Brixton task. The Brixton task was also negatively correlated to parental expectations, (FMPS Parental Expectations: $r = -.28, p = .15$), rigid dieting (RC-16: $r = -.29, p = .15$), and agreeableness (IPIP Agreeableness: $r = -.29, p = .14$), such that an increase in errors was related to a decrease in each of these variables.

The TMT was significantly negatively correlated with flexible dieting (FC-12: $r = -.60, p < .001$), such that worse set-shifting (i.e., larger TMT score) was linked with decreased use of flexible dieting strategies. Set-shifting on the TMT also had moderate to large but statistically non-significant negative associations with the HADS Anxiety ($r = -.22, p = .26$), FMPS Parental Criticisms ($r = -.32, p = .10$), RC-16 ($r = -.35, p = .08$), and IPIP Intellect ($r = -.23, p = .25$). It had non-significant positive relations with the HADS Depression ($r = .20, p = .31$) and the SQ ($r = .26, p = .21$). Thus, individuals with a larger TMT ratio (i.e., worse set-shifting) had decreased

levels of anxiety, parental criticism, rigid dieting practices, and a less imaginative approach, while they had increased levels of depression and systemizing.

The WCST perseverative error score was significantly positively associated with the FMPS Concerns about Mistakes subscale ($r = .41, p = .04$), such that larger number of errors were associated with a greater concern about mistakes. The perseverative error score also had moderate to large but statistically non-significant positive correlations with HADS Depression ($r = .24, p = .25$), FMPS Doubts about Actions ($r = .29, p = .15$), FMPS Parental Expectations ($r = .23, p = .26$), FMPS Parental Criticisms ($r = .29, p = .15$), FMPS Personal Standards ($r = .23, p = .26$), and FMPS Organization ($r = .27, p = .18$), while it had a negative relation with IPIP Agreeableness ($r = -.33, p = .10$). Individuals with a greater number of perseverative errors on the WCST tended to have higher levels of depression, doubts about their actions, parental expectations, parental criticism, personal standards, organization, and skepticism. The number of trials to complete the first category in the WCST was significantly negatively associated with the ERQ Reappraisal ($r = -.51, p = .009$) and the IPIP Emotional Stability subscale ($r = -.40, p = .04$), indicating that increases in the number of trials needed to learn the first rule were associated with decreased use of reappraisal strategies and less emotional stability. The number of trials to achieve the first category also exhibited moderate to large non-significant positive relations with HADS Depression ($r = .26, p = .19$), BDI ($r = .29, p = .16$), STAI X1 ($r = .20, p = .32$), STAI X2 ($r = .23, p = .27$), FMPS Concerns about Mistakes ($r = .26, p = .21$), FMPS Parental Criticisms ($r = .37, p = .06$), with negative correlations with the ERQ Suppression ($r = -.34, p = .09$) and SQ ($r = -.23, p = .28$). This indicates that an increased number of trials needed to achieve the first category (i.e., less efficient set-shifting) is linked with increased depression, anxiety, concern over mistakes, and parental criticisms, and with decreased emotional suppression and

systemizing. Finally, the number of categories completed on the WCST was not significantly correlated with any other measure in this group, but displayed small to moderate positive associations with FMPS Parental Criticisms ($r = .21, p = .31$), ERQ Suppression ($r = .22, p = .29$), RC-16 ($r = .18, p = .39$), and IPIP Intellect ($r = .21, p = .30$), such that decreases in the number of categories completed (i.e., worse set-shifting) were associated with fewer perceptions of parental criticism and less emotional suppression, rigid dieting, and imaginative approaches.

The strength of the correlations between the CFI and most of the self-report measures was reduced in this sample. Self-perceived ability to see multiple solutions remained significantly positively associated with personal standards (FMPS Personal Standards: $r = .44, p = .02$) and intellectual tendencies (IPIP Intellect: $r = .56, p = .002$). Although not statistically significant, it also had moderate to large negative relations to depression (BDI: $r = -.25, p = .21$) and anxiety (STAI X1: $r = -.21, p = .29$; STAI X2: $r = -.33, p = .10$). The CFI Alternatives had statistically non-significant positive correlations with concern over mistakes (FMPS Concerns about Mistakes: $r = .26, p = .20$), parental expectations (FMPS Parental Expectations: $r = .26, p = .18$), concern with organization (FMPS Organization: $r = .35, p = .07$), and systemizing (SQ: $r = .29, p = .15$). Ability to see multiple explanations was also positively linked with extraverted tendencies and conscientiousness (IPIP Extraversion: $r = .32, p = .10$; IPIP Conscientiousness: $r = .26, p = .18$). Ability to see situations as controllable showed a significant positive association with systemizing (SQ: $r = .25, p = .02$), but had non-significant positive correlations with concern with personal standards (FMPS Personal Standards: $r = .20, p = .32$), conscientiousness (IPIP Conscientiousness: $r = .38, p = .05$), and imaginative tendencies (IPIP Intellect: $r = .26, p = .20$).

As seen in Table 6, the correlations among the neuropsychological measures of set-shifting and the self-report measures of cognitive flexibility remained limited, such that increases

in ability to see multiple solutions (i.e., CFI Alternatives) was associated with increases in perception of controllability (i.e., CFI Control) ($r = .35, p = .073$) and increases in perceived controllability were linked with increases in the number of categories completed on the WCST ($r = .34, p = .09$). Additionally, a larger number of trials needed to complete the first category on the WCST was negatively associated with the TMT B : A ($r = -.33, p = .11$).

Table 6. Bivariate correlations among measures of set-shifting for participants with EAT scores greater than 19.

	CFI Alt	CFI Con	Brixton	WCST Trials to 1st	WCST C. Comp.	WCST Pers. Errors	TMT B : A
CFI Alt.	1	.35	-.07	.18	.14	.06	-.16
CFI Con.		1	-.06	.01	.34	-.09	.04
Brixton			1	.02	.04	.18	-.08
WCST Trials 1 st				1	-.06	.15	-.33
WCST C. Com.					1	-.30	.10
WCST Pers. Err						1	-.07
TMT B : A							1

* $p < .05$

** $p < .01$

EAT, Eating Attitudes Test; CFI Alt, Cognitive Flexibility Inventory – Alternatives; CFI Con., Cognitive Flexibility Inventory – Control; Brixton, Brixton total errors; WCST, Wisconsin Card Sorting Test; C. Comp., Categories Completed; Pers. Err., Perseverative Errors; TMT B : A, Trail Making Test ratio of time B : time A

The bivariate correlations were also analyzed for the participants with lower eating disorder symptomatology ($EAT-26 < 19$). No correlations between the measures of set-shifting and the independent variables differed by more than .08 from the full sample analyses. Though several correlations changed significance level, the actual changes in strength of the relations were small.

Table 7 (see Appendix A) displays the associations between high levels of each independent variable on self-report and neuropsychological measures of set-shifting separated by group (high eating symptomatology and the full sample). The nature of the relations between several of the independent variables and self-reported cognitive flexibility appeared to differ based on group, such that high obsessionality and high concern over mistakes were related to better cognitive flexibility for participants with EAT-26 scores greater than 19, but worse cognitive flexibility for the full sample. Additionally, self-doubt and parental criticism were related to self-reported cognitive flexibility in the full sample but not in the group with higher eating symptomatology. Further, level of organization was correlated with self-reported cognitive flexibility only in the subset of patients with elevated eating pathology.

As can be seen in Table 7, more neuropsychological tasks were related to the independent variables in the subset of patients with greater eating concerns. Additionally, the nature of the association between set-shifting and rigid dieting differed between the groups such that higher tendencies toward rigid dieting were related to better set-shifting in the group with potential eating disorder symptomatology, but worse set-shifting in the full sample.

Table 7 also clearly indicates that within the group with greater eating pathology, the nature of the relations between the independent variables and the neuropsychological tasks depended on the task used. The neuropsychological tasks yielded mixed results for the associations between set-shifting and anxiety, such that higher anxiety was linked with worse set-shifting when measured by the Brixton task and the WCST, but better set-shifting when utilizing the TMT. A similar pattern was seen for the FMPS Parental Criticisms subscale. High obsessionality was associated with worse set-shifting when measured using the number of errors made on both the Brixton and the WCST, but was associated with better set-shifting when

considering the number of categories achieved on the WCST. Finally, greater perceived parental expectations were related to worse set-shifting when using the number of perseverative errors made on the WCST, but better set-shifting when considering the number of errors made on the Brixton task.

Elevated depressive and anxiety symptomatology

Although not originally planned, participants with BDI scores greater than 20 ($n = 45$) and HADS Anxiety scores greater than 8 ($n = 82$) were analyzed separately to aid in avoiding interpretive mistakes in the group with elevated eating disorder symptomatology. Table 8 displays the means and standard deviations for these two groups. Importantly, there is a degree of participant overlap among these groups (e.g., individuals with both higher anxiety and depressive symptomatology) and this prevented outcomes from being compared across the three groups. However, visual inspection of the results highlight potential differences in the Brixton task, the number of WCST categories completed, and the TMT ratio of time B : A, such that individuals with greater eating pathology appeared to have a greater number of errors, fewer categories completed, and a greater discrepancy in the TMT ratio than those with depressive and anxiety symptomatology.

Table 8. Means and standard deviations on measures of set-shifting for the full sample and participants with BDI scores greater than 20 and HADS Anxiety scores greater than 8.

	BDI > 20		HADS-A > 8	
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>
CFI Alt.	66.71	8.43	67.56	8.16
CFI Con.	30.82	7.20	32.45	6.63
Brixton	12.16	3.36	12.46	3.61
WCST Trials 1st	11.93	3.31	12.19	3.57
WCST C. Com.	4.27	.92	4.22	.91
WCST Pers. Err	4.96	1.41	5.21	1.63
TMT B : A	2.23	1.07	2.64	1.09

BDI-11, Beck Depression Inventory Version 2; HADS – A, Hospital Anxiety and Depression Inventory – Anxiety Scale; CFI Alt, Cognitive Flexibility Inventory – Alternatives; CFI Con., Cognitive Flexibility Inventory – Control; Brixton, Brixton total errors; WCST, Wisconsin Card Sorting Test; C. Comp., Categories Completed; Pers. Err., Perseverative Errors; IPIP; TMT B : A, Trail Making Test ratio of time B : time A

Tables 9 and 10 indicate that the correlations between the independent variables and the measures of set shifting for the high depressive and high anxiety groups, respectively.

Differences between the eating disorder symptomatology group and these two groups are seen, both in size and direction of associations, between the outcomes and depression, perfectionism, rigid dieting, systemizing, agreeableness, intellectual tendencies, and conscientiousness. For example, the group with elevated depressive symptomatology exhibited a positive and large correlation between the number of WCST trials needed to achieve the first category and HADS Anxiety ($r = .46, p < .001$), indicating that increases in anxiety were associated with a greater number of trials needed to learn the initial rule. The group with greater eating disorder symptomatology exhibited a minimal correlation between HADS Anxiety and the number of WCST “trials to 1st category.” Further, the association between FMPS Organization and the

number of errors on the Brixton task was large and positive in the group with higher eating symptomatology, but moderate and negative in the group with increased depressive symptomatology. In this sample, higher organizational standards were related to a greater tendency to err on the Brixton task for individuals with increased eating disorder symptomatology, but were associated with fewer mistakes in individuals with elevated depressive symptomatology.

Gender Analyses

A one-way MANOVA was utilized to examine whether gender differences existed in the neuropsychological and self-report measures of set-shifting. Box's M was interpreted as non-significant ($M = 28.41, p = .51$), indicating that the covariance matrices are likely equal across dependent variables. The current sample did not appear to show gender differences across measures of set-shifting ($\text{Wilks } \Lambda = .94, F(7, 181), p = .112$). Analyses indicated that the sample had 68.5% power, however, leaving open the possibility that they were underpowered to detect a group difference.

Linear Regression Analyses

A simultaneous linear regression was utilized to determine the contribution of each independent variable to variance in set-shifting ability. Given the low correlations between the neuropsychological variables and the independent variables, this analysis was performed only for the self-report measure of set-shifting. Independent variables that had significant correlations with the CFI Alternatives subscale were entered into the model, but the BDI, STAI X1, and STAI X2 had potentially problematic multicollinearity (BDI: $\text{VIF} = 5.71$; STAI X1: $\text{VIF} = 5.07$; STAI X2: $\text{VIF} = 7.55$). As a result, the regression was re-run without these three variables, with the variance inflation factors for the remaining variables ranging from 1.20 through 2.08. As can be seen in Table 11 (see Appendix A), FMPS Personal Standards ($B = .28, SE = .13, p = .03$),

IPIP Agreeableness ($B = .28$, $SE = .09$, $p = .003$), and IPIP Intellect ($B = .33$, $SE = .11$, $p = .004$) were significant predictors of the CFI Alternatives subscale, with the IPIP Agreeableness and IPIP Intellect subscales accounting for the most variance in set-shifting (partial correlations = .22). As agreeableness, personal standards, and imaginative capacity increase, self-perceived ability to see multiple solutions also increases, with the most significant impact from agreeableness and intellect. The current model accounted for 39.9% of the variance in the CFI Alternatives scale.

When examining the CFI Control subscale, multicollinearity again proved problematic for the BDI ($VFI = 5.77$), STAI X1 ($VFI = 5.26$), and the STAI X2 ($VFI = 7.95$). These variables were removed from the regression analysis, with remaining variables' variance inflation factors ranging from 1.30 through 2.61. Table 12 (see Appendix A) displays the results from regressing the CFI Control subscale on those independent variables with which it had a significant bivariate correlation. HADS Anxiety ($B = -.37$, $SE = .16$, $p = .021$), FMPS Personal Standards ($B = .24$, $SE = .11$, $p = .027$), and SQ ($B = .13$, $SE = .08$, $p = .006$) were significant predictors, with systemizing accounting for the most variance (partial correlation = .21). As anxiety decreases and personal standards and systemizing increase, self-perceived ability to see difficult situations as controllable increases. Overall, the model accounted for 48.1% of the variance in the CFI Control scale.

Factor Analyses

Although not part of the initial design, an exploratory factor analysis was utilized to investigate the number of constructs captured by the measures of set-shifting. The mixed nature of the associations among the neuropsychological variables and the independent variables might indicate that multiple constructs are being captured. Maximum likelihood extraction with direct oblimin rotation was utilized and the model failed to converge using 25 iterations. A principle

components analysis was subsequently utilized to determine the number of components that best reproduced the observed variability seen in the current dataset. Although this type of analysis is less hypothesis-driven than an exploratory factor analysis, it allows the data to be reduced in scenarios with little previous research supporting a hypothesis-driven approach. However, the data were unable to be reduced to a good solution ($KMO = .50$), leaving it unclear how many constructs the current battery of neuropsychological tasks captured.

Discussion

Most striking about the pattern of results seen in the current study is their diversity, with some associations in a direction consistent with hypothesized relations between set-shifting and the independent variables, some showing a complex pattern apparently dependent upon degree of symptomatology, and several demonstrating a set of correlations opposite to the predicted model. The current study examined the nature of the associations among set-shifting and anxiety, depression, obsessionality, perfectionism, emotional reappraisal, dieting, systemizing, and personality factors in a normal sample and in subsets of participants with higher levels of eating, mood, and anxiety pathology. The goal was to provide more precision and context for understanding set-shifting in general and in subsets of individuals with higher levels of psychopathology. The current results make clear that set-shifting is a complex construct with multifaceted associations. Perhaps more significant than the specific findings for each variable, this research underscores the importance of defining this construct more exactly and evaluating its associations more thoroughly in future research.

The challenge of measuring set-shifting

The inconsistency seen among measures of set-shifting and their small intercorrelations indicate the difficulties in utilizing these neuropsychological tasks as sole representations of set-shifting. As noted in the introduction, the process of set-shifting likely involves multiple components, including the ability to learn new rules and to switch efficiently between rules. This may account for several of the small correlations among the neuropsychological measures of set-shifting, and suggests why associations between different neuropsychological tasks and the same independent variable might differ in size and direction. For instance, the association between the WCST outcomes and anxiety in the subgroup of participants with elevated eating concerns indicated that increased anxiety was related to poorer set-shifting, but the TMT suggested the

exact opposite relation. Understanding the differences between these two measures helps to explain these results: the WCST more clearly measures the ability to learn a new rule, while the TMT appears to capture the ability to alternate between two given rules. These two tasks may differ meaningfully from each other, resulting in a unique pattern of associations.

The current conceptualization of set-shifting, however, does not sufficiently explain why tasks that appear to measure the same component of set-shifting (e.g., the total number of errors on the Brixton task and the number of perseverative errors on the WCST) had only small and non-significant correlations. These discrepancies may be best explained by literature examining how the involvement of other mental abilities or processes may confound the measurement of set-shifting (Ionescu, 2012).

Multiple studies have provided evidence for the role of working memory and attention in the WCST task. Through altering the number of potential rules to govern sorting, it becomes possible to manipulate working memory load and directly examine how it impacts performance on the WCST (Lange, Kroger, Steinke, Seer, Dengler, & Kopp, 2016). If working memory were not involved in the task, we would not expect this change in load to influence performance; however, several studies have supported the hypothesis that working memory load affects performance on card-sorting tasks (Hartman, Steketee, Silva, Lanning, & Andersson, 2003; Lange et al., 2016). Further, in patients with schizophrenia, set-shifting deficits that have been attributed to impairment in cognitive flexibility were significantly decreased when working memory ability was statistically controlled (Hartman et al., 2003). Imaging data have also been used to further substantiate hypotheses regarding the necessity of working memory when completing the WCST task (Lie, Specht, Marshall, & Fink, 2006; Monchi, Petrides, Petre, Worsley, & Dagher, 2001).

Beyond working memory, set-shifting also relies on attentional capacities. During a paradigm like the WCST, participants must not only attend to feedback given about the validity of the rule being used, but must also be able to switch their attention to new features of the card (e.g., color, shape, number). In a sample of children with attention deficit hyperactivity disorder (ADHD), investigators found that age and IQ accounted for differences between ADHD participants and healthy control participants on outcomes related to switching rules, but did not account for the finding that the ADHD group failed to maintain set more frequently than healthy controls (Mullane & Corkum, 2007). The authors propose that this inability to maintain set may represent a failure to sustain attention, consistent with previous literature using factor analysis to analyze WCST responses in children with ADHD (Pineda, Ardila, Rosselli, Cadavid, Mancheno, & Mejia, 1998). In these analyses, ability to maintain set loaded on a different factor from the outcomes hypothesized to be reflective of flexibility (Pineda et al., 1998). Neuroimaging data documenting increased activity in the anterior cingulate cortex associated with increases in task demand provide further evidence of the involvement of attentional networks during this task (Lie, Specht, Marshall, & Fink, 2006).

Findings indicating the involvement of other cognitive processes in tasks such as the WCST support the idea that other abilities may confound results on these tasks and make it difficult to isolate specific components of set-shifting. This likely helps to explain why different tasks hypothesized to measure the same component of set-shifting may not be strongly related. Although the WCST and the Brixton both measure errors, the WCST is widely accepted as a complicated task that may require greater involvement from other cognitive abilities compared to the Brixton task. For instance, the WCST involves attention to different features of the cards, whereas the Brixton task asks participants to attend only to the movement of one circle.

Additionally, the instructions for the Brixton task explicitly tell participants that the rule governing circle movement will change, whereas participants are left to deduce the presence of rule changes on their own during the WCST (Tchanturia et al., 2012). Unfortunately, current research has not examined the contribution of other cognitive abilities to performance on the Brixton task as thoroughly as has been done with the WCST. Potential explanations for differences between the two tasks are thus only hypotheses. Future studies could include manipulations meant to influence other cognitive abilities involved in the task to better determine the extent to which they impact outcomes.

Set-Shifting and Cognitive Flexibility

“Set-shifting” has been included as a variable in a variety of contexts within the field of psychology, and has recently been utilized to represent a type of cognitive flexibility that may be inefficient in several domains of psychopathology. As previously discussed, the construct itself grew from work with patients who had suffered traumatic brain injury and was adopted by researchers and clinicians who noted that this variable might have parallels to inefficiencies in cognitive flexibility observed in some groups of psychiatric patients. In particular, researchers hoping to develop more efficacious treatments for eating disorders have relied upon a hypothesized connection between diminished set-shifting as measured by neuropsychological tasks and the cognitive inflexibility observed in patients (Galimberti et al., 2012; Tchanturia et al., 2012; Wu et al., 2014). There is limited evidence supporting the connection between these two constructs, however, and the present study suggests that they may not have the association that has previously been assumed.

The self-report measure of cognitive flexibility and the neuropsychological tasks included in the current study have both been used to represent the aforementioned cognitive inflexibility observed in patients (Wu et al., 2014), but the degree to which they are capturing the same

construct is unclear. The questions asked in the self-report measure do not appear to represent the same processes experienced in the neuropsychological tasks (e.g., “When I encounter difficult situations, I feel like I am losing control”) and the low correlations among these measures support the hypothesis that they are measuring two distinct processes. This absence of association is consistent with previous literature (Johnco, Withruh, & Rapee, 2014). Further, the factor analysis was unable to produce a good-fitting reduction into clear factors. Although the inability to produce an adequate solution does not necessarily mean that they are measuring different constructs, it speaks to the need for future research to better identify how these measures relate.

Additionally, the neuropsychological tasks and the self-report measures evidenced different associations with the independent variables, further supporting the hypothesis that the two may not be measuring the same construct. As will be discussed in greater detail in subsequent sections, depression, obsessionality, multiple dimensions of perfectionism, emotional reappraisal, systemizing, and dimensions of personality were each related to the self-report measure and apparently unrelated to the neuropsychological measures in the full sample. This could indicate that these variables are related to self-perceived flexibility but not to flexible task performance, but again, further research must be conducted to determine the nature of the relation between the two types of measures.

Future research should also consider which measure, if either, best represents the type of cognitive flexibility clinical psychologists intend to examine. While it could be argued that the self-report measure has limited validity due to poor insight or demand characteristics, it should not be assumed that the processes captured by the neuropsychological tasks are better approximations of the clinical rigidity observed in individuals with psychopathology. The types

of questions included in the self-report measure appear to subsume the cognitive inflexibility referenced by clinical psychologists in a way that the tasks do not (e.g., “When in difficult situations, I consider multiple options before deciding how to behave”). This line of research is particularly important because of the recent trend to utilize improved neuropsychological task performance as evidence of impact on cognitive flexibility in studies examining the efficacy of treatments that target set-shifting.

Set-Shifting and the Independent Variables in the Full Sample

The exploratory nature of the current research allowed an examination of the associations between set-shifting and a wide range of variables in a normal sample. This was particularly warranted because of the absence of previous research assessing how set-shifting functions in normal individuals. The number of variables included and the exploratory nature of the study, however, also resulted in a complex pattern of findings that is likely to include a number of false positives. Although potential explanations for each result could be sought, it is important to note the risk of over-interpretation. Further, the number of variables coupled with the previously discussed difficulties in understanding the associations between set-shifting and cognitive flexibility limit the extent to which general statements can be made about the associations between each independent variable and “set-shifting” as a whole. Across many of these variables, there are discrepancies between their associations with the neuropsychological tasks and the self-report measure, as well as between specific neuropsychological tasks. As discussed, these inconsistencies have multiple possible interpretations. The various measures may be capturing different constructs or specific dimensions of the same construct, may have distinct sensitivities for variance in set-shifting, or may be confounded by involvement from other cognitive abilities. Nonetheless, the current research highlights specific potential connections between set-shifting and the independent variables in the full sample.

Anxiety, depression, and obsessionality appear to relate to set-shifting in a way that is consistent with current conceptualizations of these variables as interfering with the ability to attend to information inconsistent with one's set or beliefs and with treatment protocols that challenge patients to incorporate that contradictory information into their thought processes (Beck, 1995). Previous literature detected no association between anxiety and set-shifting in samples of patients with eating disorders (Holliday et al., 2005; Roberts, Tchanturia, & Treasure, 2010), informing the hypothesis that anxiety and set-shifting would not be related. However, results indicated that higher levels of anxiety were generally associated with worse self-perceived cognitive flexibility and difficulty with initial and subsequent rule learning. Similarly, the self-report measure of set-shifting was related to depression and obsessionality in the hypothesized directions, such that increases in these variables were related to decreases in self-perceived cognitive flexibility.

The associations among the dimensions of perfectionism and set-shifting were fairly consistent with previous literature and support the current understanding of perfectionism as a potentially maladaptive quality that can be related to rigidity (Flett & Hewitt, 2006). High levels of self-doubt, anxiety concerning mistakes, parental expectations, parental criticism, and organization were associated with decreased ability to respond flexibly, while elevated personal standards were related to better self-perceived flexibility. This is potentially reflective of a meaningful difference in the impact of internally versus externally imposed standards on ability to think flexibly and highlights the need to represent perfectionism as a multifaceted construct. Future research should attempt to replicate these findings, as no previous studies included neuropsychological tasks, self-reported cognitive flexibility, and a multidimensional measure of perfectionism.

Correlations among set-shifting and rigid dieting and those for set-shifting and emotion reappraisal were consistent with hypotheses. Increased use of emotion reappraisal strategies was associated with greater self-perceived flexibility. As previously discussed, use of emotion reappraisal strategies involves the ability to see a situation from multiple perspectives and the findings from the current study support the idea that this is related to general cognitive flexibility. Higher levels of emotional suppression were also related to worse self-perceived ability to see situations flexibly. Frequent use of rigid dieting practices was also associated with decreased ability to learn new rules and more perseveration. Although direction cannot be determined, it appears that general cognitive inflexibility is consistent with rigidity in both of these domains.

The association between systemizing and set-shifting did not support initial hypotheses. Greater tendencies towards rule finding were associated with increased self-reported set-shifting ability and predicted the greatest amount of variance in self-perceived ability to see situations as controllable. Conceptually, systemizing tendencies would likely support initial rule learning and motivation to deduce a system that produces order in difficult situations. Notably, previous literature indicates that patients with high-functioning autism exhibit deficits in set-shifting (Kaland, Smith, & Mortensen, 2007) and the full sample did not exhibit an association between systemizing and the neuropsychological tasks. This might point towards a nonlinear association between systemizing and set-shifting, such that systemizing is supportive of set-shifting ability only at particular levels, or could indicate a meaningful difference between the neuropsychological tasks and the self-report measure, as already discussed.

Extraversion, agreeableness, conscientiousness, emotional stability, and intellect all related to better self-perceived cognitive flexibility, with agreeableness and intellectual

tendencies predicting the greatest amount of variance in self-reported ability to see multiple solutions. Theoretically, increases in trust and amicability could allow for a greater willingness to examine situations from multiple perspectives rather than holding onto one's initial set. Further, it makes conceptual sense that increases in curiosity and imaginative capacity would be strongly associated with ability to use multiple angles when examining a situation. This is the first study to examine the correlations between these domains of personality and set-shifting, necessitating replication, but these findings may illuminate a context for understanding how set-shifting interacts with personality.

Set-Shifting, the Independent Variables, and Eating Disorder Symptomatology

Although not planned, the current study was also able to examine participants with potential eating disorder symptomatology separately and compare the pattern of results to those seen in the full sample. The performance of these individuals on the neuropsychological outcomes was generally consistent with previous literature (Abbate-Daga et al., 2014; Holliday et al., 2005; Tchanturia et al., 2004; Tchanturia et al., 2011). As will be discussed in more detail, some of the associations between the neuropsychological tasks and the independent variables were consistent with those seen in the full sample, but several highlighted potential differences in this subgroup. Throughout interpretation of these results, however, it is important to note that the specific measure utilized in the current study (i.e., EAT-26) is limited in its capacity to identify participants with eating disorders. Consequently, this subset of participants can only be said to have elevated eating disorder symptomatology and it should not be assumed that conclusions about this group would transfer to groups with diagnosed eating disorders, or that the current findings would align with previous literature examining set-shifting in patients with diagnosed eating disorders. Further, the number of participants identified with elevated eating and weight concerns yielded insufficient power to detect group differences on many of the outcome

measures. The MANOVA indicated that there was at least one statistically significant group difference, but the overall pattern of results on the set-shifting measures did not appear strikingly different from that seen in the lesser eating pathology sample. Future research should be powered to statistically examine differences across all outcomes and determine whether set-shifting inefficiencies appear at a certain threshold of pathology.

Set-shifting and anxiety, depression, emotional reappraisal, and several domains of personality appear to have similar associations in this subgroup as those seen in the full sample. Higher anxiety and depression were associated with poorer self-reported set-shifting and more difficulty learning rules, though it should be noted that anxiety and depression in this subgroup could be driven by dietary restraint or restriction and consequently may be qualitatively different from the anxiety and depression seen in the full sample. Similarly, higher levels of emotional reappraisal were related to better self-perceived flexibility and rule learning. Further, extraversion, agreeableness, emotional stability, and intellect were related to better self-reported flexibility and increased ability to learn new rules in this subgroup of participants. The nature of these associations appears consistent with the full sample.

In contrast, high levels of personal standards and conscientiousness were associated with poorer set-shifting on neuropsychological tasks. For individuals with more pronounced levels of eating concerns, it appears that these variables function differently with respect to ability to think flexibly. They may serve as barriers to flexible thinking and could thus be considered important to manage in treatment. Mixed results were seen with respect to obsessionality and systemizing, such that higher levels of these variables were related to worse performance on some tasks and better performance on others. Further, high levels of emotional suppression and rigid dieting

were surprisingly related to better set-shifting in this subgroup. It is unclear how to interpret these mixed findings without additional research.

Beyond these specific findings, several general patterns are noteworthy. The number of significant associations between the independent variables and the neuropsychological tasks was substantially greater in this subset of participants. Depression, obsessionality, multiple dimensions of perfectionism, emotional reappraisal, dieting strategies, and several domains of personality were related to neuropsychological tasks in this subgroup, but not in the full sample. This could indicate that these variables are related to self-perceived flexibility in a normal sample and only extend to task-based flexibility at higher levels of pathology, but again, differences in pattern between the two types of measurement are difficult to interpret. Additionally, there were numerous inconsistencies among the associations between these variables and individual neuropsychological tasks used to measure set-shifting. As previously indicated, these apparent discrepancies could also be explained through numerous mechanisms. Further, it is likely that at least several are chance findings.

The discrepancies between the self-report measures of cognitive flexibility and the neuropsychological tasks measuring set-shifting were particularly striking in this subset of participants. High obsessionality, concern over mistakes, parental expectations, personal standards, organization, and conscientiousness were all related to better self-reported flexibility, but worse task-based set-shifting. Yet again, these discrepancies have multiple possible interpretations, including disparities between self-perceived flexibility and task-based flexibility and differences in intended populations for the two types of measures. Yet, this pattern was not seen in the full sample and is consistent with clinical descriptions of eating disorder patients as possessing limited insight into the problematic nature of their behaviors. If this is a further

manifestation of the egosyntonic nature of eating disorders, it is particularly informative for researchers studying set-shifting in patients with eating disorders and clinicians who hope to increase flexibility in their patients.

Set-Shifting, the Independent Variables, and Other Symptomatology

Although several correlations appeared to be distinctive to individuals with greater levels of eating pathology, examination of the full sample and this subgroup alone could lead to errors in interpretation. Perhaps these correlations are also present in groups with other forms of psychopathology, rather than being unique to individuals with eating and weight concerns. To explore this possibility, two additional subgroups were created to examine patterns in participants with elevated depressive and anxiety symptomatology. It is important to note that there is a degree of overlap among these groups, as individuals often have elevated scores in multiple domains of psychopathology; in addition, there is a large discrepancy in sample sizes across groups. Nonetheless, visual inspection of the overall pattern of results gives greater context for interpreting the nature of the differences seen between the full sample and the subgroup with greater eating disorder symptomatology.

The associations among perfectionism, rigid dieting, and set-shifting in the subset of participants with elevated eating concerns appear to differ from those seen in the groups with greater depressive and anxiety symptomatology. Perfectionism was generally associated with less perseveration (i.e., better set-shifting) in the group with depressive symptomatology and showed negligible correlations across outcomes in the group with higher anxiety. Yet, participants with more prominent eating pathology exhibited significant correlations among perfectionism and set-shifting, suggesting that perfectionism was generally associated with less flexibility. Similarly, rigid dieting was largely unrelated to set-shifting in the groups with depressive and anxiety concerns, but was related to better set-shifting in the group with elevated

eating pathology. This may highlight a particularly important area for future research focusing on cognitive treatments for eating disorders.

Examination of these subgroups also suggests that the nature of the associations among personality and task-based set-shifting differ in individuals with elevated eating pathology. The correlations among the dimensions of personality measured and perseveration were more pronounced in individuals with greater eating pathology as compared to those with elevated depressive and anxiety symptomatology. Further, the association between set-shifting and conscientiousness in these two subgroups more closely mirrored that seen in the full sample as compared to those in the group with greater eating disorder symptomatology. It appears that these associations may be not common across forms of psychopathology, perhaps indicating a specific role of personality in flexibility for individuals with elevated eating and weight concerns. As this is the first study to examine the nature of these connections, it is important for future research to continue examining the role that personality might play in flexibility. Such a series of studies might also have implications for variables that moderate response to treatments targeting flexibility.

Conclusions and Future Directions

To the best of this author's knowledge, this study represents the first attempt to examine the correlates of set-shifting in a normal sample. Given the social value placed on ability to adapt to difficult situations, a clearer understanding of these associations is worthwhile in and of itself. It allows for an initial profile of how an individual with efficient set-shifting might be described using other variables. Though the study design cannot determine causality, nor answer the question of how self-reported cognitive flexibility is related to neuropsychological measures of set-shifting, it highlights factors that may be related to flexible responding. Further, it indicates

the potential for multiple pathways to achieve or hinder flexibility, providing a better context for how these cognitive processes could function in daily life amidst other variables.

To understand the importance of these associations, however, knowledge about the extent to which cognitive flexibility as measured by self-report and neuropsychological tasks translates to flexible cognition and behavior in everyday circumstances is crucially needed. Previous research appears to generalize findings from neuropsychological tasks to behavior, but no research has directly examined transference to flexible behavior. Treatment protocols targeting set-shifting inefficiencies generally utilize changes in neuropsychological assessment as the sole outcome (Lang, Treasure, & Tchanturia, 2015), despite findings documenting the impact of practice effects on these tasks. Studies that include both neuropsychological tasks and self-report measures of cognitive flexibility tend to show no improvement in the self-report measures after CRT (Juarascio, Manasse, Espel, Kerrigan, & Forman, 2015). Further, research that attempts to measure functional impact through quality of life suggests that any effect of CRT on quality of life and eating disorder symptomatology is due to a process other than improvement on neuropsychological tasks (Dingemans et al., 2013). Current evidence suggests that it may be inappropriate to generalize performance on isolated neuropsychological tasks to behavior and cognition in day-to-day situations. If this is the case, the clinical meaning of these associations among set-shifting and the independent variables is greatly diminished.

An understanding of how neuropsychological task performance relates to functional flexibility should be a focus of future research, as this would allow researchers and clinicians to better determine the clinical importance of inefficiencies in set-shifting and the value of CRT protocols. Future investigations could include measures of quality of life to determine the extent to which set-shifting impairment relates to quality of life above and beyond other

psychopathology. Further, a single-case research design could be utilized to gather preliminary data on how increasing set-shifting performance measured by neuropsychological tasks translates to daily flexibility in eating, as well as other day-to-day tasks that require some adaptability. Given the prevalence of set-shifting difficulties across other domains of psychopathology, the value of this research would not be limited to patients with eating disorders.

The current study adds to the body of literature examining the nature of set-shifting in both normal samples and those with greater eating disorder symptomatology, but is not without its limitations. The use of a college student sample limits generalizability to the broader population, particularly to adolescents and children whose cognitive capacity is known to be continually developing. However, eating pathology is common in college students (White, Reynolds-Malear, & Cordero, 2011), making an understanding of set-shifting in this sample particularly relevant. The correlational nature of the study also prohibits determining directionality and the number of analyses conducted in this study make it highly likely that a subset of the statistically significant findings occurred by chance. Further, the absence of a measure of flexibility in an ecologically valid setting leaves a gap in the ability to interpret the extent to which the self-report and neuropsychological measures of set-shifting translate to functional flexibility.

Despite these limitations, this work adds to the growing body of literature attempting to understand how neuropsychological functioning impacts psychopathology. It provides context for those researchers and clinicians who hypothesize that a deficit in set-shifting ability is a causal factor in eating disorders. Through understanding how set-shifting operates in a normal sample and in samples of individuals with other pathology, researchers and clinicians will be

better equipped to understand how set-shifting ability might differ for patients with eating disorders.

Appendix A: Tables

Table 2. Bivariate correlations between measures of set-shifting and personality and behavioral characteristics.

	CFI Alt	CFI Con	Brixton	WCST Trials to 1st	WCST Cat. Comp.	WCST Pers. Errors	TMT B : A
HADS Anx	-.26**	-.48**	.05	.15*	-.17*	.06	-.03
HADS Dep	-.30**	-.40**	.06	-.04	-.01	-.01	-.01
BDI	-.29**	-.46**	.05	-.003	-.08	.02	.05
MOCI	-.14	-.28**	-.004	-.05	-.11	.06	.06
STAI_X1	-.30*	-.47**	.07	.02	-.07	.07	.05
STAI_X2	-.33**	-.56**	.04	-.02	-.06	.02	-.01
FMPS Conc.	-.07	-.30**	-.03	-.09	-.02	.12	.04
FMPS Doubts	-.19**	-.41**	-.03	-.03	-.08	.13	-.01
FMPS PE	.04	-.07	-.12	-.03	-.07	.18*	.08
FMPS PC	-.03	-.16*	-.11	-.06	.01	.12	-.01
FMPS PS	.30**	.25**	.03	-.03	.09	.05	.09
FMPS Org.	.08	.05	.07	-.06	-.02	.17*	.09
ERQ Reap.	.24**	.25**	.05	-.03	-.10	.09	-.03
ERQ Supp.	-.05	-.17*	-.04	-.11	-.10	.10	.09
Flex. Diet	.14	.01	.07	-.04	-.13	.14	.06
Rigid Diet	.03	-.08	.05	-.05	-.16*	.17*	.03
SQ	.40**	.40**	.09	.05	-.02	.10	.11
EAT	.002	-.12	.09	<.001	-.18*	.10	.04

Table 2 (continued). Bivariate correlations between measures of set-shifting and personality characteristics.

	CFI Alt	CFI Con	Brixton	WCST Trials to 1st	WCST Cat. Comp.	WCST Pers. Errors	TMT B : A
IPIP Extra.	.39**	.43**	.03	.04	-.01	.04	-.003
IPIP Agree.	.39**	.22**	-.01	.14	.01	-.02	-.004
IPIP Consc.	.21**	.28**	.04	-.04	.05	.05	.05
IPIP Em. Stab.	.27**	.46**	-.10	-.03	.09	-.06	-.09
IPIP Intell.	.50**	.37**	.08	.12	.09	-.06	.03

* p<.05

**p<.01

HADS Anx indicates Hospital Anxiety and Depression Scale – Anxiety; HADS Dep, Hospital Anxiety and Depression Scale - Depression; BDI, Beck Depression Inventory; MOCI, Maudsley Obsessive Compulsive Inventory; STAI_X1, State Trait Anxiety Inventory - State Anxiety; STAI_X2, State Trait Anxiety Inventory – Trait Anxiety; FMPS, Frost Multidimensional Perfectionism Scale; Conc., FMPS – Concerns about Mistakes; FMPS Doubts, FMPS – Doubts about Actions; FMPS PE, FMPS – Parental Expectations; FMPS PS, FMPS – Personal Standards; FMPS Org., FMPS – Organization; ERQ, Emotion Regulation Questionnaire; Reap., ERQ – Reappraisal; ERQ Supp., ERQ – Suppression; Flex Diet, Flexible Control Dieting; Rigid Diet, Rigid Control Dieting; SQ, Systemizing Quotient; EAT, Eating Attitudes Test; IPIP, International Personality Item Pool; IPIP Extra, IPIP Extraversion; IPIP Agree, IPIP Agreeableness; IPIP Consc., IPIP Conscientiousness; IPIP Em. Stab., IPIP Emotional Stability; IPIP Intellect/Imagination; TMT B : A, Trail Making Test ratio of time B : time A; CFI Alt, Cognitive Flexibility Inventory – Alternatives; CFI Con., Cognitive Flexibility Inventory – Control; Brixton, Brixton total errors; WCST, Wisconsin Card Sorting Test; Cat. Comp., Categories Complete; Pers. Err., Perseverative Errors; TMT B : A, Trail Making Test ratio of time B : time A

Table 5. Bivariate correlations between measures of set-shifting and personality and behavioral characteristics for participants with EAT scores greater than 19 ($n = 27$).

	CFI Alt	CFI Con	Brixton	WCST Trials to 1st	WCST Cat. Comp.	WCST Pers. Errors	TMT B : A
HADS Anx	-.19	-.15	.31	.09	-.06	.03	-.22
HADS Dep	-.14	-.14	.19	.26	.13	.24	.20
BDI	-.25	.04	.10	.29	.06	-.02	-.16
MOCI	.01	.16	.17	.08	.30	-.17	.11
STAI_X1	-.21	-.07	.12	.20	.13	.04	-.04
STAI_X2	-.33	-.11	.11	.23	.13	-.06	-.15
FMPS Conc.	.26	-.05	.04	.26	.16	.41*	-.17
FMPS Doubts	.13	-.10	.02	-.04	.17	.29	-.04
FMPS PE	.26	.15	-.28	.14	.01	.23	.03
FMPS PC	.13	.01	-.09	.37	.21	.29	-.32
FMPS PS	.44*	.20	-.03	.17	.15	.23	-.06
FMPS Org.	.35	.06	.31	-.13	.07	.27	-.09
ERQ Reap.	.15	.10	-.02	-.51**	-.07	-.03	-.08
ERQ Supp.	-.07	-.14	-.06	-.34	.22	-.01	-.07
Flex. Diet	-.10	-.11	.08	-.01	-.13	-.16	-.60**
Rigid Diet	-.07	-.04	-.29	-.17	.18	.01	-.35
SQ	.29	.45*	.18	-.23	.14	.15	.26

Table 5 (continued). Bivariate correlations between measures of set-shifting and personality characteristics for those participants with EAT scores greater than 19 ($n = 27$).

	CFI Alt	CFI Con	Brixton	WCST Trials to 1st	WCST Cat. Comp.	WCST Pers. Errors	TMT B : A
IPIP Extra.	.32	.03	-.03	-.12	.003	-.02	.01
IPIP Agree.	.19	.13	-.29	-.05	.12	-.33	-.09
IPIP Consc.	.26	.38	.27	.15	-.02	.13	-.13
IPIP Em. Stab.	.12	.14	.09	-.40*	.08	.08	.15
IPIP Intell.	.56**	.26	.10	-.11	.21	-.31	-.23

* $p < .05$

** $p < .01$

HADS Anx indicates Hospital Anxiety and Depression Scale – Anxiety; HADS Dep, Hospital Anxiety and Depression Scale - Depression; BDI, Beck Depression Inventory; MOCI, Maudsley Obsessive Compulsive Inventory; STAI_X1, State Trait Anxiety Inventory X1; STAI_X1, State Trait Anxiety Inventory X2; FMPS, Frost Multidimensional Perfectionism Scale; Conc., FMPS – Concerns about Mistakes; FMPS Doubts, FMPS – Doubts about Actions; FMPS PE, FMPS – Parental Expectations; FMPS PS, FMPS – Personal Standards; FMPS Org., FMPS – Organization; ERQ, Emotion Regulation Questionnaire; Reap., ERQ – Reappraisal; ERQ Supp., ERQ – Suppression; Flex Diet, Flexible Control Dieting; Rigid Diet, Rigid Control Dieting; SQ, Systemizing Quotient; CFI Alt, Cognitive Flexibility Inventory – Alternatives; CFI Con., Cognitive Flexibility Inventory – Control; Brixton, Brixton total errors; WCST, Wisconsin Card Sorting Test; Cat. Comp., Categories Complete; Pers. Err., Perseverative Errors; IPIP, International Personality Item Pool; IPIP Extra, IPIP Extraversion; IPIP Agree, IPIP Agreeableness; IPIP Consc., IPIP Conscientiousness; IPIP Em. Stab., IPIP Emotional Stability; IPIP Intellect/Imagination; TMT B : A, Trail Making Test ratio of time B : time A

Table 7. Comparison of the impact of the independent variables on self-report and neuropsychological assessments of set-shifting and cognitive flexibility in both the full sample and higher eating pathology groups.

	Higher Eating Pathology Group		Full sample	
	<i>Self-report</i>	<i>Neuropsychological Tasks</i>	<i>Self-report</i>	<i>Neuropsychological Tasks</i>
<i>High anxiety</i>	Worse SS	Worse SS (Brixton, Trials to 1 st) Better SS (TMT)	Worse SS	Worse SS (Categories, Trials to 1 st)
<i>High depression</i>	Worse SS	Worse SS (Brixton, Trials to 1 st , Pers. Errors, TMT)	Worse SS	-
<i>High obsessiveness</i>	Better SS	Worse SS (Brixton) Better SS (Categories, Pers. Errors)	Worse SS	-
<i>High concern over mistakes</i>	Better SS	Worse SS (Trials to 1 st , Pers. Errors)	Worse SS	-
<i>High doubts about actions</i>	-	Worse SS (Pers. errors)	Worse SS	-
<i>High parental expectations</i>	Better SS	Worse SS (Pers. Errors) Better SS (Brixton)	-	Worse SS (Pers. Errors)
<i>High parental criticism</i>	-	Worse SS (Trials to 1 st , Pers. Errors, Categories) Better SS (TMT)	Worse SS	-
<i>High personal standards</i>	Better SS	Worse SS (Pers. Errors)	Better SS	-
<i>High organization</i>	Better SS	Worse SS (Brixton, Pers. Errors)	-	Worse SS (Pers. Errors)

SS indicates set-shifting; Trials to 1st, trials needed to achieve first Wisconsin Card Sorting Task (WCST) category; Pers. Errors, WCST perseverative errors; Categories, number of WCST categories completed; TMT, Trail Making Task; Brixton, number of errors on the Brixton Test; “-“, no association

Table 7 (continued). Comparison of the impact of the independent variables on self-report and neuropsychological assessments of set-shifting and cognitive flexibility in both the full sample and higher eating pathology groups.

	ED Group		Full sample	
	<i>Self-report</i>	<i>Neuropsychological Tasks</i>	<i>Self-report</i>	<i>Neuropsychological Tasks</i>
<i>High emotional reappraisal</i>	Better SS	Better SS (Trials to 1 st)	Better SS	-
<i>High emotional suppression</i>	Worse SS	Better SS (Trials to 1 st)	Worse SS	-
<i>High flexible dieting</i>	-	Better SS (TMT)	-	-
<i>High rigid dieting</i>	-	Better SS (TMT, Brixton)	-	Worse SS (Categories, Pers. Errors)
<i>High systemizing</i>	Better SS	Better SS (Trials to 1 st) Worst SS (TMT, Brixton)	Better SS	-
<i>High extraversion</i>	Better SS	-	Better SS	-
<i>High agreeableness</i>	Better SS	Better SS (Brixton, Pers. Errors)	Better SS	-
<i>High conscientiousness</i>	Better SS	Worse SS (Brixton)	Better SS	-
<i>High emotional stability</i>	-	Better SS (Trials to 1 st)	Better SS	-
<i>High intellect</i>	Better SS	Better SS (Categories, Pers. Errors, TMT)	Better SS	-

SS indicates set-shifting; Trials to 1st, trials needed to achieve first Wisconsin Card Sorting Task (WCST) category; Pers. Errors, WCST perseverative errors; Categories, number of WCST categories completed; TMT, Trail Making Task; Brixton, number of errors on the Brixton Test; “-“, no association

Table 9. Bivariate correlations between measures of set-shifting and personality and behavioral characteristics for participants with BDI scores greater than 20 ($n = 45$).

	CFI Alt	CFI Con	Brixton	WCST Trials to 1st	WCST Cat. Comp.	WCST Pers. Errors	TMT B : A
HADS Anx	-.08	-.27	.05	.46**	-.09	-.07	.02
HADS Dep	-.16	-.17	-.04	-.01	.14	-.31*	-.11
MOCI	.06	.09	-.05	-.23	.15	-.08	.002
STAI_X1	-.05	-.05	.09	.43**	-.03	.07	.12
STAI_X2	-.13	-.32*	.06	.39**	-.01	.04	-.02
FMPS Conc.	.01	-.06	-.13	-.16	.23	-.06	-.22
FMPS Doubts	-.10	-.13	-.27	-.19	.002	-.04	-.14
FMPS PE	.05	.01	-.17	.02	-.08	.06	.14
FMPS PC	.16	.18	-.23	.05	.17	.06	-.04
FMPS PS	.33*	.44**	.04	.03	.05	.05	-.14
FMPS Org.	.10	.17	-.23	-.20	-.07	.19	-.09
ERQ Reap.	.24	.25	-.01	-.22	-.22	.02	.14
ERQ Supp.	-.16	-.18	-.26	-.15	-.02	.04	.05
Flex. Diet	.30	.40**	.02	-.05	-.17	.16	.05
Rigid Diet	.23	.30*	.03	-.08	-.07	.05	-.15
SQ	.53**	.53**	.01	.04	.01	.14	.04
EAT	.09	.16	.26	.07	<.001	-.05	-.09

Table 9 (continued). Bivariate correlations between measures of set-shifting and personality characteristics for those participants with BDI scores greater than 20 ($n = 45$).

	CFI Alt	CFI Con	Brixton	WCST Trials to 1st	WCST Cat. Comp.	WCST Pers. Errors	TMT B : A
IPIP Extra.	.50**	.40**	.05	-.04	.04	.05	-.27
IPIP Agree.	.36*	.22	.03	.24	-.01	.09	-.11
IPIP Consc.	.16	.21	-.13	-.17	-.01	.05	-.16
IPIP Em. Stab.	.13	.26	-.06	-.27	.20	.09	-.21
IPIP Intell.	.51**	.32*	.10	.22	.12	.09	.04

* $p < .05$

** $p < .01$

HADS Anx indicates Hospital Anxiety and Depression Scale – Anxiety; HADS Dep, Hospital Anxiety and Depression Scale - Depression; BDI, Beck Depression Inventory; MOCI, Maudsley Obsessive Compulsive Inventory; STAI_X1, State Trait Anxiety Inventory X1; STAI_X1, State Trait Anxiety Inventory X2; FMPS, Frost Multidimensional Perfectionism Scale; Conc., FMPS – Concerns about Mistakes; FMPS Doubts, FMPS – Doubts about Actions; FMPS PE, FMPS – Parental Expectations; FMPS PS, FMPS – Personal Standards; FMPS Org., FMPS – Organization; ERQ, Emotion Regulation Questionnaire; Reap., ERQ – Reappraisal; ERQ Supp., ERQ – Suppression; Flex Diet, Flexible Control Dieting; Rigid Diet, Rigid Control Dieting; SQ, Systemizing Quotient; CFI Alt, Cognitive Flexibility Inventory – Alternatives; CFI Con., Cognitive Flexibility Inventory – Control; Brixton, Brixton total errors; WCST, Wisconsin Card Sorting Test; Cat. Comp., Categories Complete; Pers. Err., Perseverative Errors; IPIP, International Personality Item Pool; IPIP Extra, IPIP Extraversion; IPIP Agree, IPIP Agreeableness; IPIP Consc., IPIP Conscientiousness; IPIP Em. Stab., IPIP Emotional Stability; IPIP Intellect/Imagination; TMT B : A, Trail Making Test ratio of time B : time A

Table 10. Bivariate correlations between measures of set-shifting and personality and behavioral characteristics for participants with HADS Anxiety scores greater than 8 ($n = 82$).

	CFI Alt	CFI Con	Brixton	WCST Trials to 1st	WCST Cat. Comp.	WCST Pers. Errors	TMT B : A
HADS Dep	-.17	-.17	-.04	-.10	.15	-.20	-.08
BDI	-.15	-.33**	-.03	.002	.04	-.16	.07
MOCI	.07	-.04	-.11	-.21	.03	-.02	.002
STAI_X1	-.14	-.24*	.02	.07	.07	-.04	.07
STAI_X2	-.26*	-.42**	-.02	-.03	.07	-.11	-.01
FMPS Conc.	-.01	-.15	-.11	-.25*	.15	-.07	-.10
FMPS Doubts	-.09	-.25*	-.11	-.24*	.03	.02	-.06
FMPS PE	.11	.02	-.13	-.15	-.001	.15	.07
FMPS PC	.10	.03	-.05	-.09	.05	.08	.01
FMPS PS	.39*	.28*	.03	-.03	.05	.03	.03
FMPS Org.	.17	.10	-.09	-.04	-.07	.14	.14
ERQ Reap.	.27*	.36**	.01	-.06	-.15	.05	.03
ERQ Supp.	-.03	-.12	.01	-.29**	-.12	.17	.19
Flex. Diet	.22*	.15	.17	-.08	-.12	.08	.12
Rigid Diet	.14	.14	.03	-.16	.02	.03	-.03
SQ	.46**	.44**	.06	.08	.10	-.004	.10
EAT	.06	.08	.12	-.04	-.02	-.04	-.05

Table 10 (continued). Bivariate correlations between measures of set-shifting and personality characteristics for those participants with HADS Anxiety scores greater than 8 ($n = 82$).

	CFI Alt	CFI Con	Brixton	WCST Trials to 1st	WCST Cat. Comp.	WCST Pers. Errors	TMT B : A
IPIP Extra.	.35**	.41**	.07	.08	.09	.04	-.11
IPIP Agree.	.49**	.21	-.02	.23*	.004	.02	-.05
IPIP Consc.	.17	.16	-.04	-.07	.03	.07	.04
IPIP Em. Stab.	.13	.29**	-.02	-.08	.07	.07	-.18
IPIP Intell.	.44**	.25*	.10	.18	.20	-.08	.04

* $p < .05$

** $p < .01$

HADS Anx indicates Hospital Anxiety and Depression Scale – Anxiety; HADS Dep, Hospital Anxiety and Depression Scale - Depression; BDI, Beck Depression Inventory; MOCI, Maudsley Obsessive Compulsive Inventory; STAI_X1, State Trait Anxiety Inventory X1; STAI_X1, State Trait Anxiety Inventory X2; FMPS, Frost Multidimensional Perfectionism Scale; Conc., FMPS – Concerns about Mistakes; FMPS Doubts, FMPS – Doubts about Actions; FMPS PE, FMPS – Parental Expectations; FMPS PS, FMPS – Personal Standards; FMPS Org., FMPS – Organization; ERQ, Emotion Regulation Questionnaire; Reap., ERQ – Reappraisal; ERQ Supp., ERQ – Suppression; Flex Diet, Flexible Control Dieting; Rigid Diet, Rigid Control Dieting; SQ, Systemizing Quotient; CFI Alt, Cognitive Flexibility Inventory – Alternatives; CFI Con., Cognitive Flexibility Inventory – Control; Brixton, Brixton total errors; WCST, Wisconsin Card Sorting Test; Cat. Comp., Categories Complete; Pers. Err., Perseverative Errors; IPIP, International Personality Item Pool; IPIP Extra, IPIP Extraversion; IPIP Agree, IPIP Agreeableness; IPIP Consc., IPIP Conscientiousness; IPIP Em. Stab., IPIP Emotional Stability; IPIP Intellect/Imagination; TMT B : A, Trail Making Test ratio of time B : time A

Table 11. Results of multiple regression analyses with set-shifting, as measured by the CFI Alternatives subscale, regressed on anxiety, depression, perfectionism, emotion regulation, systemizing, and IPIP personality factors.

	B	SE
HADS Anxiety	-.33	.19
HADS Depression	-.04	.22
FMPS Personal Standards	.28*	.13
FMPS Doubts about Actions	.04	.19
ERQ Reappraisal	.05	.08
SQ	.10	.08
IPIP Extraversion	.10	.08
IPIP Agreeableness	.28**	.09
IPIP Conscientiousness	-.05	.11
IPIP Emotional Stability	.08	.09
IPIP Intellect	.33**	.11

i. * $p < .05$

ii. ** $p < .01$

iii. HADS indicates Hospital Anxiety and Depression Scale; FMPS, Frost Multidimensional Perfectionism Scale; ERQ, Emotion Regulation Questionnaire; SQ, Systemizing Quotient; IPIP, International Personality Item Pool; CFI, Cognitive Flexibility Inventory

iv. Given the current sample size and using a $p < .05$ standard of significance, the model had 80% power to detect a minimum $f^2 = .04$. $f^2 = .1$ is considered a small effect size.

Table 12. Results of multiple regression analyses with set-shifting, as measured by the CFI Control subscale, regressed on anxiety, depression, perfectionism, emotion regulation, systemizing, and IPIP personality factors.

	B	SE
HADS Anxiety	-.37*	.16
HADS Depression	.001	.18
MOCI	.01	.11
FMPS Concerns over Mistakes	-.17	.09
FMPS Parental Criticisms	.23	.13
FMPS Personal Standards	.24*	.11
FMPS Doubts about Actions	-.31	.19
ERQ Reappraisal	.05	.07
ERQ Suppression	-.10	.11
SQ	.13**	.05
IPIP Extraversion	.13	.07
IPIP Agreeableness	.01	.08
IPIP Conscientiousness	.05	.09
IPIP Emotional Stability	.11	.08
IPIP Intellect/Imagination	.08	.09

i. $p < .05$

ii. $**p < .01$

iii. HADS indicates Hospital Anxiety and Depression Scale;; BDI, Beck Depression Inventory; STAI_X1, State Trait Anxiety Inventory X1; STAI_X1, State Trait Anxiety Inventory X2; FMPS, Frost Multidimensional Perfectionism Scale; ERQ, Emotion Regulation Questionnaire; SQ, Systemizing Quotient; IPIP, International Personality Item Pool; CFI, Cognitive Flexibility Inventory

iv. Given the current sample size and using a $p < .05$ standard of significance, the model had 80% power to detect a minimum $f^2 = .04$. $f^2 = .1$ is considered a small effect size.

Appendix B: Self-Report Measures

Cognitive Flexibility Inventory

Please use the scale below to indicate the extent to which you agree or disagree with the following statements.

Strongly disagree	Disagree	Somewhat agree	Neutral	Somewhat agree	Agree	Strongly agree
1	2	3	4	5	6	7

1. I am good at “sizing up” situations.
2. I have a hard time making decisions when faced with difficult decisions.
3. I consider multiple options before making a decision.
4. When I encounter difficult situations, I feel like I am losing control.
5. I try to look at difficult situations from many different angles.
6. I seek additional information not immediately available before attributing causes to behavior.
7. When encountering difficult situations, I become so stressed that I cannot think of a way to resolve the situation.
8. I try to think about things from another person’s point of view.
9. I find it troublesome that there are so many different ways to deal with difficult situations.
10. I am good at putting myself in others’ shoes.
11. When I encounter difficult situations, I just don’t know what to do.
12. It is important to look at difficult situations from many angles.
13. When in difficult situations, I consider multiple options before deciding how to behave.
14. I often look at a situation from different viewpoints.
15. I am capable of overcoming the difficulties in life that I face.
16. I consider all the available facts and information when attributing causes to behavior.
17. I feel I have no power to change things in difficult situations.
18. When I encounter difficult situations, I stop and try to think of several ways to resolve it.
19. I can think of more than one way to resolve a difficult situation I’m confronted with.
20. I consider multiple options before responding to difficult situations.

Hospital Anxiety and Depression Questionnaire

Doctors are aware that emotions play an important part in most illnesses. If your doctor knows about these feelings, he will be able to help you more. This questionnaire is designed to help your doctor to know how you feel. Read each item and circle the reply which comes closest to how you have been feeling in the past week. Don't take too long over your replies; your immediate reaction to each item will probably be more accurate than a long thought out response.

1. I feel tense or "wound up":
 - a. Most of the time
 - b. A lot of the time
 - c. From time to time, occasionally
 - d. Not at all
2. I still enjoy the things I used to enjoy:
 - a. Definitely as much
 - b. Not quite so much
 - c. Only a little
 - d. Hardly at all
3. I get a sort of frightened feeling as if something awful is about to happen:
 - a. Very definitely and quite badly
 - b. Yes, but not too badly
 - c. A little, but it doesn't worry me
 - d. Not at all
4. I can laugh and see the funny side of things:
 - a. As much as I always could
 - b. Not quite so much now
 - c. Definitely not so much now
 - d. Not at all
5. Worrying thoughts go through my mind:
 - a. A great deal of the time
 - b. A lot of the time
 - c. From time to time, but not too often
 - d. Only occasionally
6. I feel cheerful:
 - a. Not at all
 - b. Not often
 - c. Sometimes
 - d. Most of the time
7. I can sit at ease and feel relaxed:
 - a. Definitely
 - b. Usually
 - c. Not often
 - d. Not at all
8. I feel as if I am slowed down:
 - a. Nearly all the time
 - b. Very often
 - c. Sometimes

- d. Not at all
- 9. I get a sort of frightened feeling like “butterflies” in the stomach:
 - a. Not at all
 - b. Occasionally
 - c. Quite often
 - d. Very often
- 10. I have lost interest in my appearance:
 - a. Definitely
 - b. I don’t take so much care as I should
 - c. I may not take quite as much care
 - d. I take just as much care as ever
- 11. I feel restless as if I have to be on the move:
 - a. Very much indeed
 - b. Quite a lot
 - c. Not very much
 - d. Not at all
- 12. I look forward with enjoyment to things:
 - a. As much as I ever did
 - b. Rather less than I used to
 - c. Definitely less than I used to
 - d. Hardly at all
- 13. I get sudden feelings of panic
 - a. Very often indeed
 - b. Quite often
 - c. Not very often
 - d. Not at all
- 14. I can enjoy a good book or radio or TV program:
 - a. Often
 - b. Sometimes
 - c. Not often
 - d. Very seldom

Beck Depression Inventory—II

This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the **one statement** in each group that best describes the way you have been feeling during the **past two weeks, including today**. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

1. Sadness
 0. I do not feel sad.
 1. I feel sad much of the time.
 2. I am sad all the time.
 3. I am so sad or unhappy that I can't stand it.
2. Pessimism
 0. I am not discouraged about my future.
 1. I feel more discouraged about my future than I used to be.
 2. I do not expect things to work out for me.
 3. I feel my future is hopeless and will only get worse.
3. Past Failure
 0. I do not feel like a failure.
 1. I have failed more than I should have.
 2. As I look back, I see a lot of failures.
 3. I feel I am a total failure as a person.
4. Loss of Pleasure
 0. I get as much pleasure as I ever did from the things I enjoy.
 1. I don't enjoy things as much as I used to.
 2. I get very little pleasure from the things I used to enjoy.
 3. I can't get any pleasure from the things I used to enjoy.
5. Guilty Feelings
 0. I don't feel particularly guilty.
 1. I feel guilty over many things I have done or should have done.
 2. I feel quite guilty most of the time.
 3. I feel guilty all of the time.
6. Punishment Feelings
 0. I don't feel like I am being punished.
 1. I feel I may be punished.
 2. I expect to be punished.
 3. I feel like I am being punished.
7. Self-Dislike
 0. I feel the same about myself as ever.
 1. I have lost confidence in myself.
 2. I am disappointed in myself.
 3. I dislike myself.
8. Self-Criticalness
 0. I don't criticize or blame myself more than usual.
 1. I am more critical of myself than I used to be.
 2. I criticize myself for all of my faults.

3. I blame myself for everything bad that happens.
9. Suicidal Thoughts or Wishes
 0. I don't have any thoughts of killing myself.
 1. I have thoughts of killing myself, but I would not carry them out.
 2. I would like to kill myself.
 3. I would kill myself if I had the chance.
10. Crying
 0. I don't cry anymore than I used to.
 1. I cry more than I used to.
 2. I cry over every little thing.
 3. I feel like crying, but I can't.
11. Agitation
 0. I am no more restless or wound up than usual.
 1. I feel more restless or wound up than usual.
 2. I am so restless or agitated that it's hard to stay still.
 3. I am so restless or agitated that I have to keep moving or doing something.
12. Loss of Interest
 0. I have not lost interest in other people or activities.
 1. I am less interested in other people or things than before.
 2. I have lost most of my interest in other people or things.
 3. It's hard to get interested in anything.
13. Indecisiveness
 0. I make decisions about as well as ever.
 1. I find it more difficult to make decisions than usual.
 2. I have much greater difficulty in making decisions than I used to.
 3. I have trouble making any decisions.
14. Worthlessness
 0. I do not feel I am worthless.
 1. I don't consider myself as worthwhile and useful as I used to.
 2. I feel more worthless as compared to other people.
 3. I feel utterly worthless.
15. Loss of Energy
 0. I have as much energy as ever.
 1. I have less energy than I used to have.
 2. I don't have enough energy to do very much.
 3. I don't have enough energy to do anything.
16. Changes in sleeping pattern.
 0. I have not experienced any change in my sleeping pattern.
 1.
 - a) I sleep somewhat more than usual.
 - b) I sleep somewhat less than usual.
 2.
 - a) I sleep a lot more than usual.
 - b) I sleep a lot less than usual.
 3.
 - a) I sleep most of the day.

- b) I wake up 1-2 hours early and can't get back to sleep.

17. Irritability

- 0. I am no more irritable than usual.
- 1. I am more irritable than usual.
- 2. I am much more irritable than usual.
- 3. I am irritable all the time.

18. Changes in Appetite

- 0. I have not experienced any change in my appetite.
- 1.
 - a) My appetite is somewhat less than usual.
 - b) My appetite is somewhat more than usual.
- 2.
 - a) My appetite is much less than before.
 - b) My appetite is much greater than usual.
- 3.
 - a) I have no appetite at all.
 - b) I crave food all the time.

19. Concentration Difficulty

- 0. I can concentrate as well as ever.
- 1. I can't concentrate as well as usual.
- 2. It's hard to keep my mind on anything for very long.
- 3. I find I can't concentrate on anything.

20. Tiredness or Fatigue

- 0. I am no more tired or fatigued than usual.
- 1. I get more tired or fatigued more easily than usual.
- 2. I am too tired or fatigued to do a lot of the things I used to do.
- 3. I am too tired or fatigued to do most of the things I used to do.

21. Loss of Interest in Sex

- 0. I have not noticed any recent change in my interest in sex.
- 1. I am less interested in sex than I used to be.
- 2. I am much less interested in sex now.
- 3. I have lost interest in sex completely.

State-Trait Anxiety Inventory

Form X1

A number of statements which people have used to describe themselves are given below. Read each statement and blacken in the appropriate circle to indicate how you feel right now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1=Not at all

2=Somewhat

3=Moderately so

4=Very much so

- | | | | | |
|-------------------|---|---|---|--|
| 1. I feel calm. | | | | |
| 1 | 2 | 3 | 4 | |
| 2. I feel secure. | | | | |
| 1 | 2 | 3 | 4 | |
| 3. I am tense. | | | | |
| 1 | 2 | 3 | 4 | |

State-Trait Anxiety Inventory

Form X2

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate response to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement, but give the answer which seems to describe how you general feel.

1=Almost never

2=Sometimes

3=Often

4=Almost always

- | | | | | |
|---|---|---|---|--|
| 1. I take disappointments so keenly that I can't put them out of my mind. | | | | |
| 1 | 2 | 3 | 4 | |
| 2. I am a steady person. | | | | |
| 1 | 2 | 3 | 4 | |

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Maudsley Obsessive-Compulsive Inventory

Instructions: Please answer each question by putting a circle around the 'TRUE' or the 'FALSE' following the question. There are no right or wrong answers, and no trick questions. Work quickly and do not think too long about the exact meaning of the question.

1. I avoid using public telephones because of possible contamination.

TRUE

FALSE

2. I frequently get nasty thoughts and have difficulty in getting rid of them.

TRUE

FALSE

3. I am more concerned than most people about honesty.

TRUE

FALSE

4. I am often late because I can't seem to get through everything on time.

TRUE

FALSE

5. I don't worry unduly about contamination if I touch an animal.

TRUE

FALSE

6. I frequently have to check things (e.g., gas or water taps, doors, etc.) several times.

TRUE

FALSE

7. I have a very strict conscience.

TRUE

FALSE

8. I find that almost every day I am upset by unpleasant thoughts that come into my mind against my will.

TRUE

FALSE

9. I do not worry unduly if I accidentally bump into somebody.

TRUE

FALSE

10. I usually have serious doubts about the simple everyday things I do.

TRUE

FALSE

11. Neither of my parents was very strict during my childhood.

TRUE
FALSE

12. I tend to get behind in my work because I repeat things over and over again.
TRUE
FALSE

13. I use only an average amount of soap.
TRUE
FALSE

14. Some numbers are extremely unlucky.
TRUE
FALSE

15. I do not check letters over and over again before posting them.
TRUE
FALSE

16. I do not take a long time to dress in a morning.
TRUE
FALSE

17. I am not excessively concerned about cleanliness.
TRUE
FALSE

18. One of my major problems is that I pay too much attention to detail.
TRUE
FALSE

19. I can use well-kept toilets without any hesitation.
TRUE
FALSE

20. My major problem is repeated checking.
TRUE
FALSE

21. I am not unduly concerned about germs and diseases.
TRUE
FALSE

22. I do not tend to check things more than once.

TRUE
FALSE

23. I do not stick to a very strict routine when doing ordinary things.

TRUE
FALSE

24. My hands do not feel dirty after touching money.

TRUE
FALSE

25. I do not usually count when doing a routine task.

TRUE
FALSE

26. I take a rather long time to complete my washing in the morning.

TRUE
FALSE

27. I do not use a great deal of antiseptics.

TRUE
FALSE

28. I spend a lot of time every day checking things over and over again.

TRUE
FALSE

29. Hanging and folding my clothes at night does not take up a lot of time.

TRUE
FALSE

30. Even when I do something carefully I often feel that it is not quite right.

TRUE
FALSE

Frost Multidimensional Perfectionism Scale

Please select the option that best reflects your opinion, using the rating system below.

1=Strongly disagree

2=Disagree

3=Neither agree nor disagree

4=Agree

5=strongly agree

1. My parents set very high standards for me. (PE)
1 2 3 4 5
2. Organization is very important to me. (O)
1 2 3 4 5
3. As a child, I was punished for doing things less than perfect. (PC)
1 2 3 4 5
4. If I do not set the highest standards for myself, I am likely to end up a second-rate person. (PS)
1 2 3 4 5
5. My parents never tried to understand my mistakes. (PC)
1 2 3 4 5
6. It is important to me that I am thoroughly competent in everything I do. (PS)
1 2 3 4 5
7. I am a neat person. (O)
1 2 3 4 5
8. I try to be an organized person. (O)
1 2 3 4 5
9. If I fail at work/school, I am a failure as a person. (CM)
1 2 3 4 5
10. I should be upset if I make a mistake. (CM)
1 2 3 4 5
11. My parents wanted me to do the best at everything. (PE)
1 2 3 4 5
12. I set higher goals than most people. (PS)
1 2 3 4 5
13. If someone does a task at work/school better than I, then I feel like I failed the whole task. (CM)
1 2 3 4 5
14. If I fail partly, it is as bad as being a complete failure. (CM)
1 2 3 4 5
15. Only outstanding performance is good enough in my family. (PE)
1 2 3 4 5
16. I am very good at focusing my efforts on attaining a goal. (PS)
1 2 3 4 5
17. Even when I do something very carefully, I often feel that it is not quite right. (D)
1 2 3 4 5
18. I hate being less than the best at things. (CM)

- 1 2 3 4 5
 19. I have extremely high goals. (PS)
 1 2 3 4 5
 20. My parents have expected excellence from me. (PE)
 1 2 3 4 5
 21. People will probably think less of me if I make a mistake. (CM)
 1 2 3 4 5

1	2	3	4	5	6	7
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22. I never felt like I could meet my parents' expectations. (PC)
 1 2 3 4 5
 23. If I do not do as well as other people, it means I am an inferior human being. (CM)
 1 2 3 4 5
 24. Other people seem to accept lower standards than I do. (O)
 1 2 3 4 5
 25. If I do not do well all the time, people will not respect me. (CM)
 1 2 3 4 5
 26. My parents have always had higher expectations for my future than I have. (PE)
 1 2 3 4 5
 27. I try to be a neat person. (O)
 1 2 3 4 5
 28. I usually have doubts about the simple everyday things I do. (D)
 1 2 3 4 5
 29. Neatness is very important to me. (O)
 1 2 3 4 5
 30. I expect higher performance in my daily tasks than most people. (PS)
 1 2 3 4 5
 31. I am an organized person. (O)
 1 2 3 4 5
 32. I tend to get behind in my work because I repeat things over and over. (D)
 1 2 3 4 5
 33. It takes me a long time to do something "right." (D)
 1 2 3 4 5
 34. The fewer mistakes I make, the more people will like me. (CM)
 1 2 3 4 5
 35. I never felt like I could meet my parents' standards. (PC)
 1 2 3 4 5

Note. CM = Concern over Mistakes, D = Doubts about actions, PE = Parental Expectations, PC = Parental Criticism, PS = Personal Standards, O = Organization

Strongly disagree			Neutral			Strongly Agree
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Emotion Regulation Questionnaire

We would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. The questions below involve two distinct aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways. For each item, please answer using the following scale:

1. ____ When I want to feel more positive emotion (such as joy or amusement), I change what I'm thinking about.
2. ____ I keep my emotions to myself.
3. ____ When I want to feel less negative emotion (such as sadness or anger), I change what I'm thinking about.
4. ____ When I am feeling positive emotions, I am careful not to express them.
5. ____ When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm.
6. ____ I control my emotions by not expressing them.
7. ____ When I want to feel more positive emotion, I change the way I'm thinking about the situation.
8. ____ I control my emotions by changing the way I think about the situation I'm in.
9. ____ When I am feeling negative emotions, I make sure not to express them.
10. ____ When I want to feel less negative emotion, I change the way I'm thinking about the situation.

Items 1, 3, 5, 7, 8, 10 make up the Cognitive Reappraisal facet.

Items 2, 4, 6, 9 make up the Expressive Suppression facet.

Rigid vs. Flexible Dieting Scale

Flexible Control

1. When I have eaten my quota of calories, I am usually good about not eating any more.
TRUE
FALSE
2. I deliberately take small helpings as a means of weight control.
TRUE
FALSE
3. While on a diet, if I eat food that is not allowed, I consciously eat less for a period of time to make up for it.
TRUE
FALSE
4. I consciously hold back at meals in order not to gain weight.
TRUE
FALSE
5. I pay a great deal of attention to changes in my figure.
TRUE
FALSE
6. How conscious are you of what you are eating?
NOT AT ALL
SLIGHTLY
MODERATELY
EXTREMELY
7. How likely are you to consciously eat less than you want?
UNLIKELY
SLIGHTLY UNLIKELY
MODERATELY LIKELY
VERY LIKELY
8. If I eat a bit more on one day, I make up for it the next day.
TRUE
FALSE
9. I pay attention to my figure, but I still enjoy a variety of foods.
TRUE
FALSE
10. I prefer light foods that are not fattening.
TRUE
FALSE
11. If I eat a little bit more during one meal, I make up for it at the next meal.
TRUE
FALSE
12. Do you deliberately restrict your intake during meals even though you would like to eat more?
ALWAYS
OFTEN
RARELY

NEVER

Rigid Control

1. I have a pretty good idea of the number of calories in common food.
TRUE
FALSE
2. I count calories as a conscious means of controlling my weight.
TRUE
FALSE
3. How often are you dieting in a conscious effort to control your weight?
RARELY
SOMETIMES
USUALLY
ALWAYS
4. Would a weight fluctuation of 5 lb affect the way you live your life?
NOT AT ALL
SLIGHTLY
MODERATELY
VERY MUCH
5. Do feelings of guilt about overeating help you control your food intake?
NEVER
RARELY
OFTEN
ALWAYS
6. How frequently do you avoid “stocking up” on tempting foods?
ALMOST NEVER
SELDOM
USUALLY
ALMOST ALWAYS
7. How likely are you to shop for low calorie foods?
UNLIKELY
SLIGHTLY UNLIKELY
MODERATELY LIKELY
VERY LIKELY
8. I eat diet foods, even if they do not taste very good.
TRUE
FALSE
9. A diet would be too boring a way for me to lose weight.
TRUE
FALSE
10. I would rather skip a meal than stop eating in the middle of one.
TRUE
FALSE
11. I alternate between times when I diet strictly and times when I don’t pay much attention to what and how much I eat.
TRUE

- FALSE
12. Sometimes I skip meals to avoid gaining weight.
TRUE
FALSE
13. I avoid some foods on principle even though I like them.
TRUE
FALSE
14. I try to stick to a plan when I lose weight.
TRUE
FALSE
15. Without a diet plan, I wouldn't know how to control my weight.
TRUE
FALSE
16. Quick success is most important for me during a diet.
TRUE
FALSE

Systemizing Quotient

Response options: Strongly agree, slightly agree, slightly disagree, strongly disagree

1. When I listen to a piece of music, I always notice the way it's structured.
2. I adhere to common superstitions.
3. I often make resolutions, but find it hard to stick to them.
4. I prefer to read non-fiction than fiction.
5. If I were buying a car, I would want to obtain specific information about its engine capacity.
6. When I look at a painting, I do not usually think about the technique involved in making it.
7. If there was a problem with the electrical wiring in my home, I'd be able to fix it myself.
8. When I have a dream, I find it difficult to remember precise details about the dream the next day.
9. When I watch a film, I prefer to be with a group of friends, rather than alone.
10. I am interested in learning about different religions.
11. I rarely read articles or web pages about new technology.
12. I do not enjoy games that involve a high degree of strategy.
13. I am fascinated by how machines work.
14. I make it a point of listening to the news each morning.
15. In maths, I am intrigued by the rules and patterns governing numbers.
16. I am bad about keeping in touch with old friends.
17. When I am relating a story, I often leave out details and just give the gist of what happened.
18. I find it difficult to understand instruction manuals for putting appliances together.
19. When I look at an animal, I like to know the precise species it belongs to.
20. If I were buying a computer, I would want to know exact details about its hard drive capacity and processor speed.
21. I enjoy participating in sport.
22. I try to avoid doing household chores if I can.
23. When I cook, I do not think about exactly how different methods and ingredients contribute to the final product.
24. I find it difficult to read and understand maps.
25. If I had a collection (e.g., CDs, coins, stamps), it would be highly organized.
26. When I look at a piece of furniture, I do not notice the details of how it was constructed.
27. The idea of engaging in 'risk-taking' activities appeals to me.
28. When I learn about historical events, I do not focus on exact dates.
29. When I read the newspaper, I am drawn to tables of information, such as football league scores or stock market indices.
30. When I learn a language, I become intrigued by its grammatical rules.
31. I find it difficult to learn my way around a new city.
32. I do not tend to watch science documentaries on television or read articles about science and nature.
33. If I were buying a stereo, I would want to know about its precise technical features.
34. I find it easy to grasp exactly how odds work in betting.
35. I am not very meticulous when I carry out D.I.Y.

36. I find it easy to carry on a conversation with someone I've just met.
37. When I look at a building, I am curious about the precise way it was constructed.
38. When an election is being held, I am not interested in the results for each constituency.
39. When I lend someone money, I expect them to pay me back exactly what they owe me.
40. I find it difficult to understand information the bank sends me on different investment and saving systems.
41. When traveling by train, i often wonder exactly how the rail networks are coordinated.
42. When I buy a new appliance, I do not read the instruction manual very thoroughly.
43. If I were buying a camera, I would not look carefully into the quality of the lens.
44. When I read something, I always notice whether it is grammatically correct.
45. When I hear the weather forecast I am not very interested in the meteorological patterns.
46. I often wonder what it would be like to be someone else.
47. I find it difficult to do two things at once.
48. When I look at a mountain, I think about how precisely it was formed.
49. I can easily visualize how the motorways in my region link up.
50. When I'm in a restaurant, I often have a hard time deciding what to order.
51. When I'm on a plane, I do not think about the aerodynamics.
52. I often forget the precise details of conversations I've had.
53. When I am walking in the country, I am curious about how the various kinds of trees differ.
54. After meeting someone just once or twice, I find it difficult to remember precisely what they look like.
55. I am interested in knowing the path a river takes from its source to the sea.
56. I do not read legal documents very carefully.
57. I am not interested in understanding how wireless communication works.
58. I am curious about life on other planets.
59. When I travel, I like to learn specific details about the culture of the place I am visiting.
60. I do not care to know the names of the plants I see.

Eating Attitudes Test

Please place an (X) under the column which applies best to each of the numbered statements. All of the results will be strictly confidential. Most of the questions directly relate to food or eating, although other types of questions have been included. Please answer each question carefully. Thank you.

Response options:

Always

Very Often

Often

Sometimes

Rarely

Never

1. Like eating with other people.
2. Prepare foods for others but do not eat what I cook.
3. Become anxious prior to eating.
4. Am terrified about being overweight.
5. Avoid eating when I am hungry.
6. Find myself preoccupied with food.
7. Have gone on eating binges where I feel that I may not be able to stop.
8. Cut my food into small pieces.
9. Aware of the calorie content of foods that I eat.
10. Particularly avoid foods with a high carbohydrate content (e.g., bread, potatoes, rice, etc.).
11. Feel bloated after meals.
12. Feel that others would prefer if I ate more.
13. Vomit after I have eaten.
14. Feel extremely guilty after eating.
15. Am preoccupied with a desire to be thinner.
16. Exercise strenuously to burn off calories.
17. Weigh myself several times a day.
18. Like my clothes to fit tightly.
19. Enjoy eating meat.
20. Wake up early in the morning.
21. Eat the same foods day after day.
22. Think about burning up calories when I exercise.
23. Have regular menstrual periods.
24. Other people think that I am too thin.
25. Am preoccupied with the thought of having fat on my body.
26. Take longer than others to eat my meals.
27. Enjoy eating at restaurants.
28. Take laxatives.
29. Avoid foods with sugar in them.
30. Eat diet foods.
31. Feel that food controls my life.

- 32. Display self control around food.
- 33. Feel that others pressure me to eat.
- 34. Give too much time and thought to food.
- 35. Suffer from constipation.
- 36. Feel uncomfortable after eating sweets.
- 37. Engage in dieting behavior.
- 38. Like my stomach to be empty.
- 39. Enjoy trying new rich foods.
- 40. Have the impulse to vomit after meals.

Demographics

What is your gender?

- Male
- Female
- Other

How old are you?

What year are you in school?

- Freshman
- Sophomore
- Junior
- Senior

Are you currently diagnosed with or being treated for an eating disorder?

- Yes
- No

Are you currently diagnosed with or being for obsessive-compulsive disorder?

- Yes
- No

Are you currently diagnosed with or being treated for severe depression?

- Yes
- No

Which race do you identify with (select only one):

- African American, Black, African, Caribbean
- East Asian (Chinese, Korean, Japanese, etc.)
- South Asian (Indian, Pakistani, Sri Lankan, etc.)
- Southeast Asian (Vietnamese, Cambodian, Filipino, etc.)
- European American, White, Anglo, Caucasian
- Hispanic American, Latino(a), Chicano(a), Mexican, Columbian
- Pacific Islander (Micronesian, Melanesian, Samoan, etc.)
- Native Hawaiian, American Indian, Alaskan Native
- Biracial, Multiracial

What is your ethnicity? (open-ended question)

International Personality Item Pool

Representation of the Goldberg (1992) markers for the Big-Five factor structure

Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence. Indicate for each statement whether it is 1. Very Inaccurate, 2. Moderately Inaccurate, 3. Neither Accurate Nor Inaccurate, 4. Moderately Accurate, or 5. Very Accurate as a description of you.

1. Am the life of the party. (1+)
2. Feel little concern for others. (2-)
3. Am always prepared. (3+)
4. Get stressed out easily. (4-)
5. Have a rich vocabulary. (5+)
6. Don't talk a lot. (1-)
7. Am interested in people. (2+)
8. Leave my belongings around. (3-)
9. Am relaxed most of the time. (4+)
10. Have difficulty understanding abstract ideas. (5-)
11. Feel comfortable around people. (1+)
12. Insult people. (2-)
13. Pay attention to details. (3+)
14. Worry about things. (4-)
15. Have a vivid imagination. (5+)
16. Keep in the background. (1-)
17. Sympathize with others' feelings. (2+)
18. Make a mess of things. (3-)
19. Seldom feel blue. (4+)
20. Am not interested in abstract ideas. (5-)
21. Start conversations. (1+)
22. Am not interested in other people's problems. (2-)
23. Get chores done right away. (3+)
24. Am easily disturbed. (4-)
25. Have excellent ideas. (5+)
26. Have little to say. (1-)
27. Have a soft heart. (2+)
28. Often forget to put things back in their proper place. (3-)
29. Get upset easily. (4-)
30. Do not have a good imagination. (5-)
31. Talk to a lot of different people at parties. (1+)
32. Am not really interested in others. (2-)
33. Like order. (3+)
34. Change my mood a lot. (4-)
35. Am quick to understand things. (5+)
36. Don't like to draw attention to myself. (1+)
37. Take time out for others. (2+)

- 38. Shirk my duties. (3+)
- 39. Have frequent mood swings. (4-)
- 40. Use difficult words. (5+)
- 41. Don't mind being the center of attention. (1+)
- 42. Feel others' emotions. (2+)
- 43. Follow a schedule. (3+)
- 44. Get irritated easily. (4-)
- 45. Spend time reflecting on things. (5+)
- 46. Am quiet around strangers. (1-)
- 47. Make people feel at ease. (2+)
- 48. Am exacting in my work. (3+)
- 49. Often feel blue. (4-)
- 50. Am full of ideas. (5+)

The numbers in parentheses after each item indicate the scale on which that item is scored (i.e., of the five factors: (1) Extraversion, (2) Agreeableness, (3) Conscientiousness, (4) Emotional Stability, or (5) Intellect/Imagination) and its direction of scoring (+ or -). These numbers should not be included in the actual survey questionnaire.

For + keyed items, the response "Very Inaccurate" is assigned a value of 1, "Moderately Inaccurate" a value of 2, "Neither Inaccurate nor Accurate" a 3, "Moderately Accurate" a 4, and "Very Accurate" a value of 5.

For - keyed items, the response "Very Inaccurate" is assigned a value of 5, "Moderately Inaccurate" a value of 4, "Neither Inaccurate nor Accurate" a 3, "Moderately Accurate" a 2, and "Very Accurate" a value of 1.

Once numbers are assigned for all of the items in the scale, the values are summed.

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